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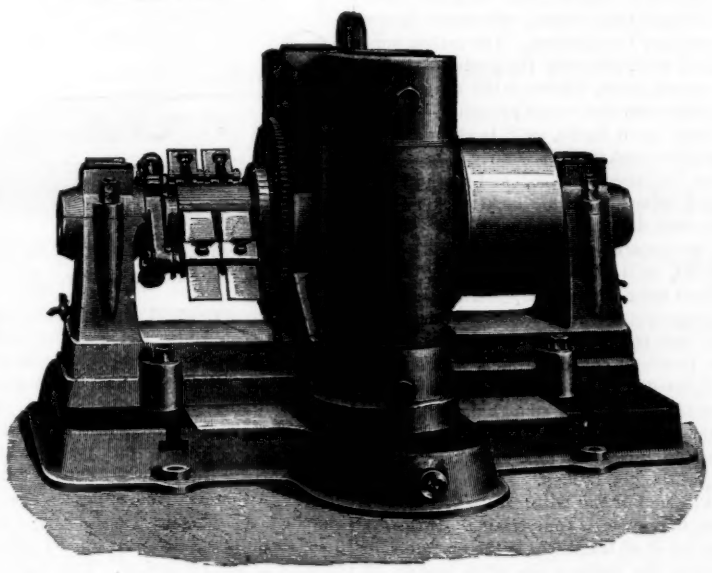
Brown's Dynamo for the Transmission of Energy.

In November last year, the engineering works at Oerlikon, in Switzerland, completed a set of four dynamo machines for a large installation, transmitting energy between Kriegstetten and Solothurn, a distance of about five miles. These machines were made to the design of Mr. C. E. L. Brown, and two of them were intended to work as generators at Kriegstetten, where there is a water power varying between 30 horse power and 50 horse power, and the other two machines, which were of slightly smaller size, were intended to act as motors, working a factory at Solothurn. Our contemporary, the *Industries*, of London, published a report of some trials made with these machines before they left the works at Oerlikon. The report consists of an official part, signed by Herr J. Amsler-Laffon, on behalf of a committee composed of prominent engineers and scientific men, and of an appendix by Mr. Brown, in which he gives some interesting information on the general features of the installation, and his reasons for choosing the particular arrangement which we are about to describe. The two generators and the two motors are connected in series, and the circuit consists of three wires of pure copper, each 235 mils. diameter, supported by telegraph posts and fluid insulators. At one place the three wires have to cross the River Aare, and since the span there is nearly 400 feet, the copper conductors are replaced by silicon bronze wires of the same size, and approximately of the same conductivity. The average span between the posts over the rest of the line is 180 feet. Both the generators and motors are series wound. The reason why Mr. Brown chose the three-wire system will be apparent from the consideration that it is extremely difficult, if not altogether impossible, to work two motors coupled in series by the same current, and insure them running at the same speed, if they are both independently loaded, and the difficulty is still further increased if there is any chance of the load being varied. It will generally be found that, under such conditions, the equilibrium is unstable, one motor gaining speed and the other losing it, unless the load itself is of a character to act as a controlling agent, or there is some automatic speed regulating apparatus provided, which, of course, would introduce too much complication. If, however, the motors are mechanically coupled then there is no difficulty in working them in series. It does not appear, from the report mentioned above, whether the motors are to be worked independently of each other, or coupled together; but, at any rate, the arrangement chosen by Mr. Brown (which is virtually nothing else but Edison's three-wire system applied to motors) makes independent working possible. As long as both motors do equal work, no current flows in the central or balancing wire; but if the work between the motors differs, a differential current flows either in one or the other direction through the balancing wire, in just the same way as a differential current flows through the third wire in the Edison distributing system, if the number of lamps on each side of it is different. Another advantage of the three wire system, as applied to transmission of energy, is, that by no possibility can the E. M. F. of two generators be thrown upon a single motor. The resistance of each wire, five miles long, is about 5 ohms, so that if both generators and both motors are at work, and giving equal power, the total resistance of the line is about 10 ohms. The resistance of the two generators is given as 6.94 ohms, and that of the two motors as 6.50 ohms, making a total resistance of the circuit of about 23½ ohms. The resistance of the armature and field are respectively 1.40 and 2 07 for each generator, and 1.30 and 1.95 for each motor. The generators have been designed to absorb, under ordinary working conditions, each about 25 horse power, and to produce a current of 14 to 15 amperes, and a total of 2,500 volts E. M. F. when driven at a speed of 700 revolutions. The motors have been designed to absorb the energy thus supplied, minus that consumed by the line, and to run at about the same speed. Mr. Brown states, however, that the machines are designed with an ample margin, and in case of a partial breakdown, nearly the whole of the work could be done with the remaining generator and motor. If, on account of lack of water power, only one pair of machines is worked, the third wire can, by means of switches, be added to either the outgoing or returning lead, and thus the actual loss of energy due to the heating in the external circuit, it is claimed, can be reduced by about 25 per cent, as compared with the loss if only two wires are used; and the proportional loss, instead of being doubled, is only increased by 50 per cent. Since all the four machines are series wound, it was easy to make the motors self-regulating, by a proper choice of the configuration of the field, quantity of iron in the armature and magnets, and by a suitable winding, so that the two characteristics of the machines should differ only by the amount representing the loss of pressure in the line. To protect the machines against lightning, should the line be struck, lightning arresters, with earth connection, will be placed at the generating and receiving stations Provision is also made for interrupting the current, without danger to the machines or attendant from excessive self-induction, by the use of fluid cut-outs at the receiving station. Should, from a short circuit or other cause, the current through the generators become too strong, automatic apparatus shunts the field magnet coils at the generators, thus causing the field to vanish, and reducing the E. M. F. to almost nothing. We may mention that Messrs. Siemens have for many years adopted the same plan for causing, without actual break of the circuit, the current of series dynamos to be reduced to nothing, or nearly so.



THE BROWN DYNAMO FOR TRANSMITTING ENERGY.

A Heat Battery.

Mr. J. A. Kendall has devised a novel battery consisting essentially of two metal plates having a saline or vitrified substance called the "medium" between them. One plate is exposed to hydrogen, the other to heated air or oxygen. Platinum gives good results as the metal, but gold, palladium, and iron may be used. Clay saturated with chloride of sodium or potassium, and fire-brick permeated with vitreous matters, may be used for the medium. The cell is heated and the hydrogen traverses the medium and is believed to combine with the oxygen or air. The electric current is drawn off by terminals connected to the plates as in an ordinary voltaic cell.

Electrical Transmission Through Air.

M. J. Borgmann has succeeded in transmitting static electricity through the air for a distance of 1½ meters. One terminal of a Wiedemann galvanometer was connected to earth, the other to a platinum wire placed in the flame of an insulated spirit lamp. At a distance of 1½ meters from the lamp an ordinary Bunsen burner was connected to a Holtz machine, the other conductor being put to earth. When the lamp was lighted the galvanometer showed no current, but when the Holtz machine was worked there were distinct indications of a current, which were steady when the disk of the machine was rotated at a uniform rate, and reversed when the disk was turned the other way.

Technical Education at Sibley College, Cornell University.

Professor Robert H. Thurston, the distinguished director of Sibley College, the Engineering Department of Cornell University, is not only one of our foremost practical engineers, but he unites with his engineering skill the faculty of expressing clearly and forcibly the grand plans for technical education whose execution is placed in his hands.

"The prosperity of the people of any country is dependent, primarily, upon their own industry and integrity, skill and enterprise, persistence and 'pluck,' and, to a considerable extent, upon the natural advantages and resources of the country itself, as determined by the character of soil and climate, and upon the location with respect to home and foreign markets and sources of supply of raw material; but the prosperity of a nation is the greater, other things being equal, as the value of the labor of the working classes is increased, and the value of such labor is the greater as the products of industry are more generally the result of trained skill, and cultivated taste and talent, employed in the so-called skilled industries. Trade education, schools of the mechanic arts and of engineering, the cultivation of industrial art, the promotion of the fine arts, in such manner as to give to the worker the intelligence and skill needed to enable him to do good work, and to provide new and broadening fields of labor, free from the fatal competition that causes each laborer to become the enemy of his neighbor, are the resources upon which only we may rely for the relief of the pressure characterizing modern civilization. Those States, and those nations, will evidently be the most successful and prosperous in which the aim of legislation, and of the educational system, is to secure the effective training of the laborer, and to the worker in the higher fields of industry the most thorough training for his work

"Education must be directed in such manner as to give, in the least possible time and in the most effective way, at least a preparation for the duties of daily life. From this time on, he who would accomplish most in either of the departments of skilled industry, or in either of the branches of the great profession of engineering, must combine scientific attainments with experimental knowledge of facts and phenomena, mechanical ability and good judgment and taste ripened by large experience in business and familiarity with the ways of the world. It is only when manual training and trade schools are found in every town, technical schools in every city, and colleges of science and art in every State, so united in a system that shall insure to every one the privilege of learning the scientific basis of any art, and of laboring in every or any branch of industry, as to make certain a recompense for all the zeal, intelligence, skill and industry that the worker may exhibit, that the professions will attain their grandest development, science and art find closest and most fruitful union, and that the citizen may enjoy to the fullest extent all that he may rightfully demand in his pursuit of all that life and liberty can offer him, and the most perfect happiness that can come to man. The highest skill, the most reliable labor, and the most admir-

able artistic talent are to be obtained only by systematic cultivation, and the new features of modern education are those which are directed to the object above outlined.

"Experience has shown that systematically planned and carefully conducted schools of science and of the arts are vastly more efficient in the education and training of young people than any workshop or mill can possibly be. In them, every operation may be thoroughly taught, and the learner may be familiarized with every detail without loss of time or strength on the part of either teacher or pupil. It is such a system, incorporated into the education scheme of every European country, that has given them, notably in the case of France and Germany, such rapid growth in productive power and prosperity, and which has, for a time, threatened other nations with such serious competition. It is now recognized as an obvious principle that in order that a nation may prosper under existing conditions of competition and cheap transportation of materials and products, the people must be so much better educated in the principles, and trained in the practice, of the arts in which they compete with other nations that their marketable productions may be introduced into the markets of the world, competing both in quality and price with all that may be there encountered, and yet the producers may receive better remuneration for the day's work by their ability to make a day's work more productive through the exhibition of greater skill, or the invention of better machinery, and by the exhibition of finer taste and better knowledge of art.

"The modern systems of technical education are directed towards these vitally important ends, and it is perfectly evident to every intelligent citizen that the prosperity the nation is, for the future, to be mainly dependent upon the success and rapidity with which this system is introduced throughout the land."

It would be impossible to express more forcibly the objects, the necessity for, and the advantages to come to the nation as to the individual from the thorough technical training of our young men in the sciences and industrial arts. Now, after more than a year's good work, we are able to congratulate Professor Thurston upon the success which has attended his intelligent and devoted efforts in this great cause, the greatest that can enlist the intelligence and labor of man; the advancement in intelligence, usefulness, and comfort of his fellow men, and through this the prosperity of the nation.

The Sibley College of Cornell University will, under the broad and enlightened policy laid down for it, become one of the most potent means of attaining these ends. The facilities it offers for the acquirement of practically useful knowledge, and for the attainment of the most thorough scientific training, are attracting to it the attention of the entire country; no wonder its halls are crowded with intelligent students.

Howell's Carbon Cutting Machine.

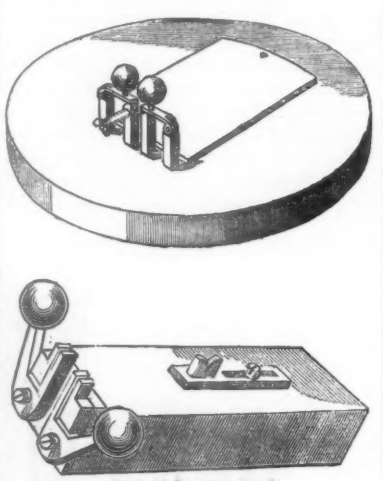
What is likely to prove an invention of great practical value and economy in the use of battery cells is now on its trial at the works of Mr. T. J. Howell, or rather of the limited company of which he is the manager, at Hamilton road, Grove road, Mile End. This is a new and speedy process of reducing retort carbon to the dimensions required for use in cells. By the old method it is well known that the pieces of carbon as they left the retort had to be chiseled down and then ground to the requisite size and smoothness, involving a great amount of labor and no little waste of the material itself. Mr. Howell, however, has devised a machine which obviates to a great extent both these drawbacks. The irregular blocks of carbon are first placed in a wooden frame and embedded in layers of cement, in which condition they remain for about a week, by which time the whole becomes solidly welded together. The mass is then operated upon by his patent carbon cutting machine, which can cut thousands of carbon plates at one process.

Incandescent Lamp Manufacture.

By J. Swinburne.

In the early days of incandescent lighting the carbons were clipped to the platinum wire mechanically, but that method is now generally abandoned in favor of mounting by deposition of carbon over the joint. Joints are also made by cementing the carbons into a socket in the platinum wire, and a mechanical grip, with copper deposited over it, is sometimes used. The Swan lamp was for a long time made with a carbon mounted in a socket, and the joint short-circuited over to make good connections. The process is as follows: The platinum wires are first cut into lengths, and the ends flattened out by a fly press into little spades. These spades are then drawn through a wire draw plate, so as to curl the flat part round into a tube. The wires are then sealed into glass stems, and these stems are sent to the mounting room. The legs of the carbons are inserted in the tubes and the tubes slightly pinched, so as to hold the carbons more or less securely; the stems are then held by an apparatus which clips the platinum wires quite close to the little tubes or sockets. A smaller short-circuiting clip leans against the legs of the carbon hard enough to make good contact, but not hard enough to run the risk of breaking the carbon. The whole is then immersed in benzol and a current is passed through, so as to heat the carbon between the short-circuiting clip and the little tubes of platinum. The benzol is, of course, decomposed by the heat, and carbon is deposited over the joints forming a hard lump, which effectually fastens the carbons to the wires. The carbon must be held vertically with the platinum up and the carbon down, otherwise the deposit does not come over the socket properly. Benzol is a very good liquid, as it is cheap; but it soon gets black, and it is dirty in use. Mr. Swan has tried aniline, and aniline and benzol mixed. Aniline makes a very neat joint, and deposits very hard gray carbon; but it is expensive, and the use of it is to be avoided, as it is poisonous, and the fumes evolved when it is decomposed by heat contain cyanogen. Aniline also attacks the skin, and is apt to give great trouble if it gets into any cut or scratch. Alcohol or methylated spirits is cleaner, but takes a long time to give a thick enough deposit. This method has several disadvantages. The platinum tubes take time to make, and they frequently get broken. If the tubes are broken, and if the wires are sealed into the glass, the waste is considerable. If the carbons are at all fragile, or if the operators are careless, the carbons are often broken off, leaving little bits in the tubes. These can sometimes be picked out with a needle, but the stem is generally wasted. The writer has introduced the process of mounting by short-circuiting without sockets. The platinum wires are mounted in a stem, and the stem is held by two current-conveying clips. The carbon is held so that the ends touch the platinum wires, and a little cement is applied to the joint. The whole is then placed in an atmosphere of coal-gas, enriched with benzol vapor. The circuit is made through the joints, and the current is gradually increased till they are raised to a white heat. When enough carbon has been deposited to make firm and strong joints the process is finished.

The writer's apparatus is shown in Figs. 1 and 2. The cover is removed to show it more clearly. A pair of clamps hold the stem in position by gripping the platinum wires firmly; the platinum wires are bent out to exactly the right shape by a little machine, which will be described under the head of glass blowing. The carbon is mounted on a holder, which consists of a block of hard wood, with clamps at one end. These clamps are made so that they hold the carbon with its legs just the right distance apart. The carbons may have been previously cut to gauge, so that the legs are exactly the same length, or they may have been broken off short at the jaws of the flashing clips. The latter plan is the best; the movable gauge is arranged so that the carbons must be mounted the correct length. When the carbon is placed on the block, and the weights released, so as to exercise gentle pressure, the block is placed on the brass plate, and slid about till the ends of the carbon just touch the platinum wires. A cement of paste of dextrin and plumbago is applied with a camel's-hair brush, and left a few minutes to dry. While it is drying, the operator prepares another, as each works two short-circuiters. When the cement is partly dried, a current is sent through. The circuit enters by one of the platinum clips, and crosses to the carbon, and returns by the other platinum clip. The block for holding the carbon is made detachable, so that the carbon can be placed more easily in it. A brass plate is fastened for it to rest upon, as the wood is otherwise apt to warp, so that the ends of the carbons do not come opposite the wires. When the carbon is placed, a glass cover is put over the apparatus, and the gas is turned on. The gas enters under the joints, so as to give them a good supply, and it goes out by a tube at the other side. An ordinary glass shade is



Figs. 1 and 2.—See Incandescent Lamp Manufacture.

used. Mercury should not be used as a seal. A better plan is to stretch a broad rubber band over the edge of the glass, so as to make a sort of inside flange; if the glass is evenly cut, this is practically air-tight. Care must be taken that the cement is raised to a white heat, otherwise the joints will be weak, and the carbons will be apt to tumble off the platinums. When the carbons are mounted, the stems are placed in trays which hold them the right way up, so that the carbons do not get broken. The trays consist of boards about 10 in. square, with 100 quarter-inch holes, bored about half way through. It is generally necessary to have several blocks for each apparatus, as the brass work gets hot. Care must be taken not to let the glare from the white-hot joints hurt the eyes of the operator. The glass shades are covered with sheet lead, leaving only the top unprotected. If there is an explosion, the lead prevents the glass from doing harm. A piece of colored or smoked glass is fixed over the shade, so that the operator can watch the process without injuring his eyes. The electrical part of the apparatus is very simple; it consists of means of regulating the current through the joints. An alternating current machine is very useful. A Siemens machine can be easily arranged to have four or eight circuits, with five or nine terminals. The current through each apparatus is then governed by induction coils, with movable cores. One coil is arranged in series with the apparatus, and the other in shunt. The cores of the solenoids are bundles of iron wire, or even rods of iron, though the latter are apt to get hot. The cores are made so as to be slid in or out. At starting, the shunt core is right out, and the series one in, so that the series one practically stops the current, while what little current there is goes by the solenoid in shunt, instead of through the legs of the carbons. To increase the current, the shunt core is pushed in gradually, and the series pulled out, till the whole electromotive force of the machine is on the apparatus and the shunt coil takes almost no current. If the machine is suitable, its self-induction will make the electromotive force fall rapidly, as the current increases, which is just what is wanted.

If direct currents are used, as is generally the case, as it is seldom worth while to have an alternating machine for the purpose, the best method is to use secondary batteries. The cells are connected with a switch, which allows the number in circuit to be increased or diminished. An ordinary switch with a solid contact will not do, as, if the contact is made to touch the next section before it leaves the one it is on, one of the cells will be short circuited, while, if it leaves one section before it touches the next, the circuit will be broken for a moment altogether. The moving arm has, therefore, two contact pieces, with a resistance between them which will stand two volts and a reasonable current for a short time, and these touch neighboring sections at the same time for a moment. If secondary cells are not available, adjustable resistances are arranged in shunt and in series, just as in the case of the induction coils above mentioned. Water resistances are the best for all work in which exact resistances are not wanted. They are made with lead plates in dilute sulphuric acid. The plates are so arranged that one can be drawn out of the water, or so that the path from one plate to the other through the electrolyte can be made longer or shorter. Of these methods the writer prefers that with the alternating machine and induction coils, or deadeners. He has used Dr. Hopkinson's adjustable closed circuit deadeners, and they act very well, though a cheaper and less efficient form may sometimes be better.

If the platinum wires are not mounted in glass stems, but are supported at the time of sealing, it is more easy to make good contacts to start the short circuit, as the wires can be separately adjusted to the ends of the carbons. The process can thus be carried on under liquid, which is quicker. The ends of the platinum wires may be flattened a little and turned over, so that the ends of the carbon rest against flat surfaces. In mounting carbons for low resistance lamps, it is best to work with liquid, and great care must be taken to make the joints of very highly conducting carbon, otherwise they will get very hot when the lamp is run, and the joint may soon go. Though short-circuiting is generally the best method many makers mount in other ways. Edison, Maxim and Weston use carbons with thickened ends, and clamp the ends. Maxim and Weston use a little bolt and nut and washer. Edison clamps the carbon mechanically, and then deposits copper over the joints by electrolysis. The thickened ends have the objection that they absorb gases, and thus make the lamp more troublesome to exhaust. Carbons made with thickened ends are also more expensive to make, as each carbon has to be made separately, while most carbons are made in thread, a great length being produced at a time.

With short-circuited joints, if a twenty-candle power carbon is broken a little too short it can often be used for a sixteen candle power lamp of lower volts. Electroplated joints are bad, because if the lamp is run bright the copper volatilizes, and either strikes an arc across from one joint to the other, or at least assists the silent discharge that is always present when the lamp is run bright. In lamps with imperfect vacuums copper from the terminals form very curious trees of beautifully fine copper filaments. These little trees grow till their fibers intermingle. Some makers fix the ends of the carbons into sockets made by curling the platinum wires into spirals, and cement them in with something plastic, which can be carbonized, such as cement of tar and black-lead. The cement can be carbonized by heating the carbon, with short wires attached, and the carbons cemented into them, and the wires can then be mounted by soldering them to other wires embedded in the glass stem. These cements are always troublesome, however, as they occlude gases and water vapor, and give trouble in exhaustion.

Electrical Distribution by Alternating Currents and Transformers.

By Rankin Kennedy.

TRANSFORMERS.

A very simple and most convenient form of transformer employed by me in some experiments in 1885 consists of a laminated Siemens shuttle-wound armature, *s*, in Fig. 15, half size. On this was wound 40 turns of No. 12 wire as a secondary, *c*, *d*, and over this 800 turns No. 24 silk covered wire as a primary, *a*, *d*, the length of the armature being about 6 inches This form gives very good results for self-regulation and economy, and I use it generally for distribution purposes for small installations, say up to one or one and a half horse power.

The outer sheathing may be of iron wire or of iron discs, and should be made so that the armature may be withdrawn for repairs.

Fig. 16 shows the construction of the large transformers employed by me to raise the pressure of the electric energy at the generating station ; it is built up entirely of hoop iron and bound together by bolts as shown. The primary coils and the secondary coils are wound on a mould and then slipped on ; the thick wire, which is in this case the primary, being first put on, and the secondary or fine wire slipped over it ; finally, the strips of iron are placed on the ends and this closes the magnetic circuit. The lamination and ventilation in this form are very perfect.

The Ferranti transformers, Fig. 17, end view, and Fig. 18, side elevation partly in section, are also built entirely of hoop iron. The hoops are laid out in four bundles, *C*, *C*, *C*, *C*, Fig. 17, straight and close together ; the thick secondary wire, *D*, *D*, Fig. 18, is wound on over the middle portion of the bundles of hoop iron, and over this thick wire the fine primary wire is slipped in sections which have been previously wound on a mould. The hoop iron bundles are then divided at *X*, *X*, Fig. 18, into halves, one-half bending up over the top and the other bending down under the bottom, thus closing the magnetic circuit ; finally, the whole is enclosed in a cast-iron shell, *A*, *A*. The lamination in this construction is hardly perfect as the flat side of the iron is presented to the penetration of the lines of force, but altogether it is a very practicable construction.

There are many other forms of transformers, but as they are all similar in principle and are merely simple modifications of the leading types herein described, they are not of sufficient interest to occupy space here.

In America the parallel system and the closed magnetic circuit transformer have been introduced by the Sun Electric Company of Woburn, Mass., under the name of "Mr. Slattery's system," and also by the Westinghouse Company, of Pittsburgh.

Slattery's system embraces a simple ring converter, the same as my 1883 converter.

The Westinghouse Company have obtained the patent of Gaulard and Gibbs in America, the claims in which I give here complete.

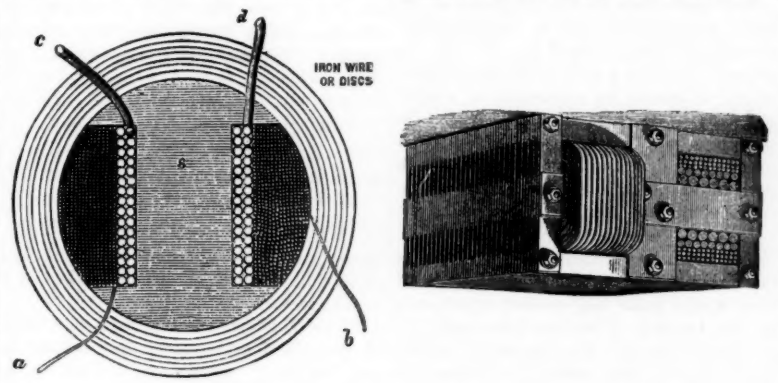
1. The hereinbefore-described art or method of electrical distribution and conversion, which consists in establishing in a closed electric circuit, a current of alternate and equal positive and negative potential, producing by the influence of such current an inductive field of alternate polarity, and thereby inducing in translating devices situated in an independent closed circuit traversing such field, a similar alternating secondary current of greater quantity and less potential than the originating or producing current.

2. In a system of electrical distribution, an inductorium or converter, in which the length of that portion of the conductor traversed by the primary current within the magnetic field created by itself, exceeds the length within the same field of the conductor traversed by the secondary current, in combination with a dynamo-electric generator producing alternating electric currents or pulsations of equal potential and duration, and translating devices actuated by said secondary current.

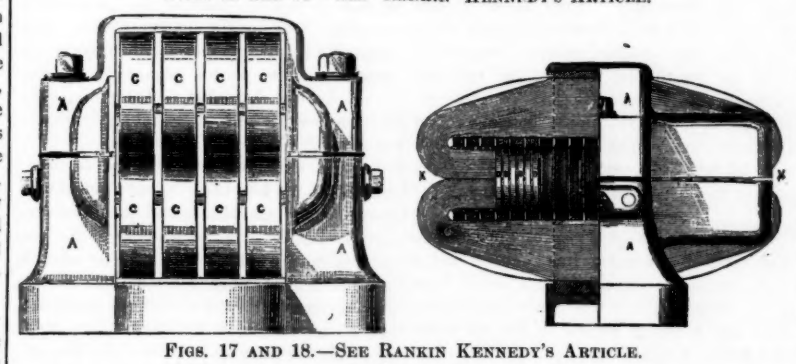
3. In a system of electrical distribution, an inductorium or converter, in which the resistance of that portion of the conductor traversed by the primary current within the magnetic field created by itself, exceeds the resistance of that portion of the conductor traversed by the secondary current which lies within said field, in combination with a dynamo-electric generator producing alternating currents or pulsations of equal potential and duration, and translating devices actuated by said secondary current.

4. In a system of electrical distribution, a dynamo-electric machine, organized for the production of alternate positive and negative currents, equal to each other in potential and duration, in combination with the primary circuit of an inductorium or converter organized to induce in its secondary circuit alternating currents of lower potential and greater quantity than those of the primary circuit, and one or more translating devices actuated by said secondary currents.

5 In a system of electrical distribution, the combination of an inductorium or converter, having its primary and secondary circuits constantly closed, a dynamo-electric generator for producing alternating currents of equal potential and duration included in said closed primary circuit, and one or more translating devices included in said closed secondary circuit, substantially as set forth.



Figs. 15 and 16.—See Rankin Kennedy's Article.



Figs. 17 and 18.—See Rankin Kennedy's Article.

These claims construted into simple language mean simply that Gaulard and Gibbs claim to be the only true inventors of the parallel system of working potential transformers at constant E.M.F. in the mains. The patent is dated October, 1886.

Judging from recent utterances in America, where the introduction of this system has created a somewhat amusing flutter among the electrical fraternity, the distinctions existing between the two systems, series and parallel, are not yet recognized, for the simple reason that the parallel system with the potential transformer has been bodily imported by them from Britain in a complete and perfect form. The series system has never been tried in America, and therefore they have had none of the failures attending attempts to work that system. The parallel system has been a great success, but it was just as great a success in Europe two years ago.—*London Electrical Review.*

* * A dispatch from Kankakee, Ill., says: Mr. Carpenter, of Berlin, Germany, made a trial trip with a train of thirty Illinois Central freight cars supplied with his air-brake, the valves of which are worked by electricity. The run was over the Illinois Central track from Chicago to Kankakee and return. The dynamo is carried on the left side of the locomotive The instantaneous setting and unsetting of the brakes was perfect. This was the first trial of the invention in America, though it is used in Germany.

Duplex Telephony.

Although the telephone has been in use for ten years, little has yet been done in "duplexing" the wires—probably because telephony is mainly carried on over short distances. The expense attending the erection of copper lines has, however, led those engaged in the work of promoting long-distance telephony to seek some means of increasing the capacity of the wires, and we believe experiments have been made by the American Telephone and Telegraph Company between New York and Philadelphia, a distance of 90 miles or so. It is obvious that if a wire of that length can have its capacity doubled by a system of duplexing, there are advantages which will more than outweigh the necessity for complicating the arrangements at the transmitting and receiving stations. The difficulties are much greater than in the case of the telegraph ; but they can be surmounted by bringing the double-wire instruments at the terminal stations into inductive relation with both sides of the circuit by means of converting or repeating coils. In a paper read by Dr. A. M. Rosebrugh before the Canadian Institute, the author gives an account of a method of duplexing telephone lines which he devised some time ago and, by the advice of Prof. S. P. Thompson, patented in this country in 1885. In long-distance telephony the best results are obtained when two line wires are used, one being employed as a return, and Dr. Rosebrugh's object was to utilize the metallic circuit so that either two telephone subscribers or a telephone subscriber and a central office operator at each end could communicate simultaneously without interference. To accomplish that object, it is necessary to render the receiving telephones at the central office neutral to the subscribers' transmitters, and also to make the subscribers' receivers neutral or irresponsive to the transmitters at the central office. Dr. Rosebrugh solved the first problem with comparative ease by adopting the following plan. At each central office, and at each end of the metallic circuit, a subscriber's line was attached ; but instead of using the ordinary receiver with a single coil, a telephone with a double coil was employed—one coil being inserted in one branch and the other in the other branch of the metallic circuit, the connections being so made that electrical currents traversing one coil would be neutralized by those traversing the other. That is to say, the coils were connected differentially, and the electrical currents set up from the subscribers' transmitters passed through the two coils in opposite directions, and consequently neutralized each other. Therefore, if two subscribers, one at each end of the metallic circuit, were using the line, nothing would be heard in the central office telephone. The problem how to render the subscribers' telephones neutral to the transmitters at the central office was far more difficult of solution, and Dr. Rosebrugh made many experiments before he succeeded in devising an arrangement which would answer. He ultimately found that the only solution was to so arrange the transmitters at the central office that both branches of the metallic circuit, would be charged equally, simultaneously, and in opposite directions. By charging one wire positively and the other negatively, the electrical equilibrium can be disturbed without affecting that of the subscribers' lines. Dr. Rosebrugh has discovered several ways of accomplishing that, but in his paper he describes only two, which are presumably the methods he prefers. In the first he employs a transmitter with two induction coils, the primaries being connected either in series or in multiple arc, and the secondaries connected in circuit to the respective branches of the metallic circuit. In the other method repeating coils are used with one coil in each branch of the circuit, the coils being connected with each other, and also with an independent telephone circuit. The operation in the first case is as follows. The impulses imparted to the diaphragm by the voice vary the strength of the local battery circuit traversing the primaries of the two induction coils, thus generating currents in the secondaries which, in turn, create currents in the two branches of the metallic circuit, equally and simultaneously, if the two coils are properly balanced. Adjustable cores are used, so as to obtain perfect balancing. If the connections are properly made, the electrical impulses will traverse the circuit in opposite directions, the currents generated in one coil being reinforced by those in the other. The converse is also true, for if the connections of one coil are reversed, the currents generated are opposed by those in the other, and no current will traverse the circuit. The currents will, however, meet at the subscribers' lines, and being reinforced will proceed to earth through the subscribers' telephones. Advantage may be taken of this to use two sets of transmitters at the central office or at any point of the metallic circuit, and they may be connected in such a manner that the subscribers' telephones will be responsive to one, but not to the other. Dr. Rosebrugh would, however, prefer to give the subscriber both a return wire and a ground wire ; also two sets of apparatus—one for ordinary use, the other on the duplex system for long-distance work. When repeating coils are used for charging the two branches of the metallic circuit, the latter are charged indirectly through the repeaters ; the advantage of which is that two subscribers at each end of the circuit can communicate simultaneously without interference, one using a line connecting directly with the metallic circuit, the other a line connecting indirectly by means of the two repeating coils. The subscribers, it will be seen, have the advantage of two conductors instead of one ; the resistance of the line is reduced by a half, and the working of long-distance telephone lines is much improved. This branch is confessedly only in its infancy ; but the systems devised by Dr. Rosebrugh show something of the possibilities which may become actualities when the telephone itself is free from the restrictions placed upon efforts to develop its capabilities by those who hold the governing patents. Duplex telephony paves the way for, and will no doubt develop into, quadruplex ; indeed, Dr. Rosebrugh indicates a means of enabling four subscribers at each end to use the line simultaneously.

It is doubtful if this system is perfected so as to be commercially practicable for use here in this country for sometime yet.

—— The Cleveland Electric Light Company are still further increasing and have added another Westinghouse engine of 75 horse power, making seven in all in that station.

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GEO. WORTHINGTON, - - - Editor
CHARLES W. PRICE, Associate "
LOREN N. DOWNS, President.
ANDREW J. DAM, - Vice-Pres't and Treas.
C. C. HASKINS, } Consulting Electricians.
GEO. A. HAMILTON, }

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Sometime in 1886, in order to settle once for all the comparative merits of several thousand kinds of railroad brakes, the C. B. & O. Railway donated the use of a good long section of track, containing appropriate grades, curves, etc., to make the test as thoroughly practical as possible.

As is usually the case in all such tests there were some who were not satisfied, and arrangements are made for a second trial In this second attempt electricity is to have a showing. The Illinois Central has equipped a train of thirty freight cars with an air-brake arrangement which is applied or released by electricity. The generator is placed on the left side of the engine. A trial was made a few days since between Chicago and Kankakee, the result of which was eminently satisfactory, the action of the brakes being simultaneous throughout the entire train of thirty cars.

It is estimated that the moving of the down town exchanges of the Metropolitan Telephone Company into the new building in Cortlandt street, and the improvements, will aggregate an expense of $225,000.

Judge Voorhies, of New Orleans, decides that the city has no right to impose a pole tax of $5 per pole on the telephone company of that city. This is a very satisfactory victory for the Great Southern Telephone Company.

The Bell Telephone Company is trying to remedy the change in its business at Rochester, N. Y., by opening thirteen public stations, and keeping messenger boys to run out and get people living near with whom other people may wish to converse. The telephone business in Rochester, remarks an exchange of that city, is killed. So much the worse for the business of Rochester, if that is the case.

Any comparison of the steadiness of arc lights made by the eye is unsatisfactory. It is suggested that a small spot of light be allowed to fall on a strip of sensitized paper, which is moved by clockwork at a rapid rate. After development the variation in steadiness will be indicated by inequalities in the line developed on the paper, dark parts indicating increase, and light parts decrease of illumination.

The scientific schools would confer a benefit upon the electrical community if they would make and publish experiments on the burning of various makes and sizes of carbon pencils. The data might include candle power, life, current, electromotive force, resistance, specific gravity, and per cent. of impurities. Each sized carbon should be tried with current strengths, varying from the smallest amount required to form an arc to the limit of the carrying capacity of the pencil, test of current, E.M.F., life, and steadiness being made at the same time. In this way the vexed question of the right sized carbon for a given current might be once for all settled.

Sometime ago the city inspector of Chicago discovered a grounded line, contact being made through a screw eye in a heavy floor timber at least fifteen feet above the ground. The light is one of several in the salesroom of a notion house.

Recently a plant was being inspected when the matter was referred to and the experiment was suggested of measuring the insulation of the heavy wooden posts in the second story of a warehouse. Contact was made by attaching the wire to a pocket knife, the blade of which was stuck into a post. The measurement showed an insulation resistance far below one megohm.

In a plant which shows a sort of general debility in the matter of insulation, and especially in a new structure, these facts give an inspector one more "suspect," and the constructor one more enemy to guard against.

Henry Mackay, experienced lineman, aged 30 years, while working on a Brush pole line in Detroit, on Wednesday last, touched a live wire, and fell from the pole to the street, fatally injuring himself by the fall. In a large majority of instances where death occurs from electric light current, this is the constantly repeated experience. The current does not kill, it stuns or paralyzes the victim, who falls and breaks his neck or is fatally injured. The same current passing through the individual, while standing upon the ground, if the line is properly insulated, is not thought of for more than a minute or so, and the effects are soon over. Cases of this nature are by no means rare, but never get into the papers, because they do not result fatally.

If the electric light lineman will take the precaution to strap himself to the pole, so that when he lets go he will not fall, or, if he will wear the Detroit harness, these casualties will become of very rare occurrence, if they are not done away with altogether. This class of accidents does not include those where the current does kill—where the body becomes part of the main line.

CAPILLARY ATTRACTION AND DAMPNESS.

While we are thinking about this matter of insulation and the electric light man's most implacable enemy, dampness, let us not forget that capillary attraction is a factor of no mean importance in this matter. Everybody knows that a towel left hanging out of a wash bowl will empty the bowl; but how many electric light men have any idea of the distance dampness will crawl along a cable braiding, up or down hill?

An experiment has been tried with the hope of getting a reasonably correct answer to this query. The cable was carried out horizontally, one end being immersed in water. The galvanometer showed dampness one hundred and thirty feet from the source. How much farther it would have gone is unknown. The experiment was discontinued for want of time and opportunity, in the hope of going further another time. That other time has not yet been reached. The creeping, crawling—by whatever name we call it—was the result of capillary attraction, and a fiber fabric which extends along a cable will carry moisture a long way. This is another good pointer for constructors and inspectors, and explains the bad action of many a covered joint.

HOW TO BECOME AN ELECTRICAL ENGINEER.

"What course would you advise for a young man who wishes to be a first-class electrical engineer?" an amateur asked of a well-known scientist.

"I would advise you to pursue the studies of one of the leading technical schools in this country, paying strict attention to mechanical engineering. Next a year's study abroad in one or more of the polytechnic schools. During the entire course, time should be spent on theoretical study, at the same time by no means neglecting practice in mechanical branches. Therefore, combine shop work with practical and theoretical study."

It is a common fault in the scientific schools to burden the student's mind with description of machinery and processes now entirely out of date, on account of the progress in the arts and sciences. The mind is taxed to remember A's machine, and B's process, and C's system, and D's operation, and E's method, and F's device or contrivance, and the purpose in view which brought to light all these is entirely lost sight of. On graduating, he finds himself called upon to give advice or direction to others. He often fails; he has not learned to rely on himself, or had practice in adapting means to ends, mechanically speaking. When he first began scientific study, new methods and processes suggested themselves to his mind. Some, perhaps, were foolish; the rest may have been impracticable, and occasionally one of some merit. The instructor, already overworked, has cynically smiled at him; his courage is gone, and he is now content to be fed on the husks of old harvests. The fundamental principles of the physical and mechanical should be taught experimentally, the pupil handling the apparatus himself, and making measurements under the eye of his instructor. He should be taught to construct simple instruments for himself, and be given problems to work out experimentally, which have not yet been solved; and enough there are of them, and simple ones too. Frequent exercises may be given in inventing, devising methods and means to accomplish a desired end. An electrical engineer, while not an inventor to a great extent, should have the learning and training to devise all necessary devices and perfect all details. For it is on such apparently unimportant matter that the success or failure of a system depends.

General Superintendent A. C. White, of the Providence Telephone Company, is inspecting the large telephone exchanges, and in company with Mr. Frank Harrington will visit New York. Washington, Pittsburgh, Cincinnati and Chicago. Mr. White is at the head of one of the best managed telephone companies in the country, and has the interests of 3,410 subscribers to look after, over 2,200 of that number being in the city of Providence.

OUR CHICAGO LETTER.

(From a Special Correspondent of the ELECTRICAL REVIEW.)

The town of Lake electrician, Mr. Don A. Palmer, has recently submitted his annual report to the President and Board of Trustees, this being the fifth annual exhibit of that character.

Lake, contiguous as it is to both Chicago and Hyde Park, on the north and east, is connected by fire wires with both these departments, so that, including its own force, the three may be considered one—a necessity which the immense stockyard interests demands.

The fire alarm and police system of Lake consists of 59 public and four private Gamewell fire alarm boxes, telephone lines running to all offices, etc., rendering the whole a complete though simple, perfect system, covering 125 miles of line wire, and a total value of pole lines, boxes and miscellaneous apparatus in the electrical department of over twenty-one thousand dollars. Mr. Palmer is well satisfied with his exhibit, and only needs one order from the board to render his life quite enjoyable. His territory is overrun with electric wires which have been run "regardless," and he has thus far failed of getting some provision made for a proper inspection of the lines.

The Central Electric Company is wiring the Laclede Hotel, on Wabash avenue, near Van Buren, for an 80 call annunciator. In Armour & Co.'s offices in the Home Insurance Building it is connecting all the heads of departments with bell calls. The company has recently filled an order for 100,000 pins for a cross arm contractor down in Ohio. The Central people seem to be reaching out, and the fact that the wires are not all underground is attested by the demand for insulator pins.

Fred. Degenhardt, the irrepressible representative of the Standard Underground Cable here, reports a sale of 10,000 feet of 100 wires, No. 22 cable, to the M. & K. Telephone Company, and added to this 5,000 feet of No. 18 single wire cable, and to the Ohio Valley Telephone Company 2,532 feet of 150 wire cable, of No. 20 wires.

If Fred. could only get Capt. Gifford to tell him the story of a pair of cavalry pantaloons which formed part of the gallant captain's experience during the late unpleasantness, it is not at all certain but that a receipt in full would be a fair recompense on the part of the cable company.

The half dozen gas companies in and around Chicago have consolidated everything in their line under one blanket, and hereafter when the gas company is mentioned it will not be mistaken for the other, or the new, or the old, the Equitable, or the People's.

The new corporation will be known as the Chicago Gas and Trust Company, with a capital of $25,000,000, and the following officers: Sidney A. Kent, president; Columbus R. Cummings, treasurer; and C. T. Yerkes, temporary secretary, to be succeeded soon by the present secretary of the Consumers' Company, Mr. Addix.

Now, among the incorporators of the gas company are found gentlemen who are also interested in recent electric light and power organizations, and who are preparing to operate extensively in electrical paths. They claim that they are going to monopolize the electrical power business here.

The Chicago Arc Light and Power Company, of Chicago, was incorporated a few days since with a capital of $1,000,000. The incorporators are Columbus R. Cummings, Sidney A. Kent, Marshall Field, John H. Barker, and C. N. Fay.

On the same day a certificate was filed to record the change of name of the Illinois Pan-Electric Telephone Company, at Chicago, to the Illinois National Improved Pan-Electric Company.

Notice was made in these columns some time since of the organization of the Chicago Edison Company. That company had a meeting on the 29th, and elected the following board of d rectors: A. F. Seeburger, Edson Keith, R. T. Lincoln, John Crerar, J. B. Drake, J. W. Doane, F. S. Gorton, A. A. Sprague, J. L. Thompson, P. L. Yoe, and E. M. Phelps, after which the meeting adjourned until the 2d of May for the purpose of electing officers.

The Edison Electric Light Company (Western Department) covering seventeen Southern and Western States and Territories, including Illinois, Wisconsin, and Minnesota, will hereafter be in the hands of Messrs. Humbird & Gorton, with headquarters at 185 and 187 Dearborn street, Adams Express Building, in the same rooms with the former company, at least for the present.

A friend who has recently returned from the East, says in the matter of batteries he has had much fun by way of professing to be in search, as a novice, of a constant primary battery for lighting and power purposes.

He says the way the battery people think of themselves and of the other fellows may be graphically shown in a tabulated form something like this. The statements are supposed to be in reply to questions asking, "What do you think of the Q. S. L. (quick, strong, lasting) battery? They claim, as compared with yours, 199.9 per cent. of efficiency. Give us your opinion of their efficiency as well as that of yours compared with theirs, and also state what battery you consider best:"

No.	Opinions.	They have per cent.	Best is	Mine has per cent.
1	Made on wrong principle.....	20	mine	106
2	Just good for nothing	10¼	mine	109
3	Bet $50 they dare not loan us one to test.....	31	ours	140
4	Infringement on mine. Shall see them.....	85	mine	160
5	Current runs wrong way. Eats up the carbon...	—12	ours	225

In the last instance only the office boy was found. Proprietors were out.

The Illinois regulators are still having a circus over the telephone matter. All effort appears now to be concentrated upon Senator Bacon's bill, which limits the rates to $36 per annum, with a $50 penalty for violation of the law.

On the 28th an amendment was offered making the rental $50, whereupon Senator Bell made a statistical display, showing that the Peoria Exchange was paying a profit of 155 per cent. on the capital.

Peoria must be an exception to the general rule. The Central Union Company runs that office. The stock of the company is only worth about 50 cents on the dollar, and the dividends have been 4 per cent. per annum for a couple of years back. If Mr. Bell desires, he can probably purchase stock at far less than par.

Senator Bell called attention to the attempt to evade the law in Indiana, and offered an amendment fixing the price at $12 per annum, with an additional charge for each message sent.

This would make the average Chicago newspaper, which for years has virtually been singing:

Free 'phones forever, shout it, my man,
Down with the Bell, boys,
Up with the Pan,
While we rally round the 'phone, boys,
Rally round the 'phone,
Mad because we can't get a free one.

The matter has gone to the State Printer, and is to be made a special order for the 3d of May.

A good story is told here of an electrical gentleman, who, in the absence of the type writer girl, undertook to do his own type writing. The machine is one of that kind which has the punctuation marks and figures on the same keys with the letters, but an extra key brings these into play.

Having got pretty well along with his letter he brought in the F. and P. wheel to use a comma, and forgetting to restore it, he went on with the balance of the letter, something after this style:

"The samples are about done :56) 96'!) 703 ; $— 86'$ 46 : c42$5 ? !"

The rest of the letter was largely verbal, and extremely high flavored and tinted.

CHICAGO, May 2, 1887.

OUR BOSTON LETTER.

(From a special correspondent of the ELECTRICAL REVIEW.)

The Boston Electric Light Company have moved their executive offices to the corner of State and Devonshire streets. The main entrance is at No. 17 State street, and the passenger elevator at 47 Devonshire. The rooms are on the third floor, Nos. 3-6 inclusive. Entering room No. 5, general business office, on the right is the cashier's room No. 6, open to the gaze of a visitor through a grated window. In No. 6 there is a large vault and store closet and lavatory, which are lighted with Sun lamps attached to flexible cords. The woodwork has ash finish, and the walls are tinted in old gold, the surface being oiled so that they may be washed. In the general business office there are speaking tubes, annunciators, telephone and switches controlling the incandescent lamps. In one corner of the room there is the desk of the New England agent of the Brush-Swan Electric Light Company, Mr. Frank Ridlon. In the center of the ceiling there is a combination gas and electric chandelier, four gas and four incandescent burners. Near the four corners of the ceiling there are 50 candle power, 100 candle power, group of colored and a group of clear lamps. The brilliant lighting of this room can hardly be equaled. No. 4, the treasurer's room, has tinted walls, stenciled ceiling, and artistic dado. It is lighted by a four light electrolier and two desk brackets. The above mentioned rooms front on Devonshire street. Room No. 3, at the corner of the building, looks upon Devonshire, State streets, and the old State House, the wooden image of the lion rampant here appears as if in retreat, utterly frighted by the glare of Boston's arc lights. A six light electrolier and numerous swing brackets have been placed in this room. The latter are of new pattern and design, and are adjustable in every direction. This, the directors' room, and the treasurer's room are handsomely carpeted, and the general office floor is covered with tile imitation oilcloth. In a small closet in the hallway there is placed the transformer manufactured by the Sun Electric Company, of Woburn, Mass. The whole is enclosed in a neat cast-iron frame. The officers are F. A. Gilbert, president; Hugh O'Brien, vice-president; S. S Sias, secretary and treasurer; Fred. A. Swan, incandescent and motor superintendent; M. S. Lewis, arc light inspector, and in charge of rights of way and construction department; P. Fahey, general superintendent; James O'Neil, general engineer.

The town of Spencer, Mass., is second to none in the State in enterprise. Last week the Spencer Gas Company, Judge Hill, president, started an electric (arc) plant of the Ball unipolar system, to light a portion of the streets and the town hall. The plant was installed by F. E French, and is giving such satisfaction that petitions have been presented calling for lights requiring double the present dynamo capacity.

A 35 light Ball divided arc plant has been started in the Phœnix Woolen Company's mill, East Greenwich, R I., by W. D. Warren, local agent for the Ball system for Rhode Island. The power is obtained from the main shaft.

The Brush Electric Light Company, of Niagara Falls, N. Y., supply current for arc and incandescent lights on the Canada side. No duties have ever been paid on the current sent to the other side of the river and none have been asked. The bill before the Massachusetts Legislature relating to the Sunday blue laws has been made the target of some queer amendments. Among those to be exempt from the law, it is proposed to place "gas or electricity for illuminating purposes, heat or motive power." We can picture to our minds the agony of the average Massachusetts legislator and lobbyist after encountering the electric fluid in some of its more subtle forms.

Dr. A. V. Garratt, superintendent of the Chemical Electric Light and Power Company, delivered, April 26, 1887, before the Boston Scientific Society, an interesting and instructive lecture on electrical dynamos. The subject was ably treated in a scientific and popular manner, and illustrated by lantern slides.

The bill authorizing gas companies to furnish electric light has again been postponed by the House of Representatives. There has developed a strong feeling against any general law of this kind. If every gas company earnestly desiring to engage in the electric light and power business, had presented a petition to the General Court for an amendment to their own particular charter, none, probably, would have been refused. As it is they ask for a general law allowing gas interests to enter into the electrical field without granting electric light companies an equivalent right, that of manufacturing and selling gas. The difference requires a strong light to see, that between tweedle-dee and tweedle-dum.

The Newton Common Council voted to contract with the Newton Electric Light and Power Company for the lighting, for one year from June 1, of 71 1,200 candle power arc lights, at 50 cents per night, for twenty nights per month, and all night. The street light committee recommended giving the oil lighting to the same company; also the lighting of 700 incandescent lights twenty nights each month until midnight, 400 to be of 25 candle power, and 300 of 20 candle power, and at $15 per post per year.

Prof. Moses G. Farmer, the inventor of the telegraphic fire alarm, and formerly connected as electrician with the United States Torpedo Station at Newport, R I, has purchased the Goodwin farm at Elliott, Me., and will erect a summer residence there for the children of the Wanderers' Home.

The West-End Land Company, controlling the West-End Railroad Company and the Suburban Railroad Company, have made propositions to the South Boston, Metropolitan and Cambridge horse railroads for a basis of consolidation. The West-End Land Company claim to own a controlling interest in the stock of the three last mentioned railroads. Never before has there been shown so little opposition to the schemes of the various surface and elevated railroad companies, and the public are becoming educated to the establishment of a comprehensive system of overhead roads operated by electricity.

The Sun Electric Company, of Woburn, Mass., are busy filling orders for their alternating current transformer system. Six hundred lamps capacity is to be added to the present 400 light plant of the Boston Electric Lighting Company, at their Ferdinand street station, and the City Hall and Court House will be lighted entirely by this system. The reliability and entire self-regulation of Mr. Slattery's transformer system, as shown in Boston, Portsmouth, N. H., and Bridgeport, will make it a favorite. The last two mentioned cities have given orders to double their present plant, increasing from 200 to 600 lights each. The present plants are admirable illustrations of the practicability and suitability of the induction system, in which lamps are disposed at widely different points, notwithstanding which the incandescence of lamps on various circuits, and under varying loads, is almost absolutely uniform. Mr. Slattery employs an electromotive force of 1,000 volts in the main or primary circuit, and as lamps may be more economically operated, as far as regards loss on line and interest on conductors, three miles from the generator on this sytem than for one mile under the best condition of direct current multiple arc distribution, a territory of over twenty-seven square miles can be supplied from one station.

The town of Gardner, Me., has contracted through Mr. Frank Ridlon, of the Brush-Swan Electric Light Company for a 500 light incandescent plant. The old woolen mills will be fitted with steam engines and boilers, as auxiliary power to the water wheels, which under ordinary circumstances will drive the dynamos. It has been found that, in the experience of Maine towns possessing surplus water power, incandescent lights can be supplied at a less cost than kerosene. In some places a water privilege may be rented at a merely nominal sum per horse power, say $2 to $5 per annum. By employing 20 candle lamps maintained at 14 or 15 candles so long life is obtained that the expense of lamp renewals (usually by far the largest item when cheap water power is employed) is reduced to a very insignificant figure.

The Mayor vetoed the franchises of the hot water-under-the-streets-distributing company and of the transfer of the rights of certain parties to dig up the streets, to lay and maintain conduits for underground wires to the American Conduit and Construction Company. The first was passed by the Board of Aldermen unanimously, and the second by a vote of 8 to 3 over the Mayor's veto. The opinion of the corporation counsel is that the rights granted in 1881 to open streets and lay wires have lapsed. When the underground question in New York is successfully settled Boston will place wires underground at once.

Boston, May 2, 1887.

Porous Pots for Primary Batteries.

To the Editor of Electrical Review:

If your correspondent, A. V. Garratt, will take any carbon cup and heat it to redness in a common stove fire for ten minutes, and then slowly cool it down, he will have a porous (carbon) cup adapted for all battery purposes. The connection on the top having been made, it must be surrounded by hot paraffine to secure against attack by the acid rising quickly through capillary action.

Washington, D. C., April 9. E. B.

The East Tenn. Telephone Company has changed management, and has located its headquarters in Nashville, Tenn. O. F. Noel has been elected president. Mr. Noel is also president of the Cumberland Company. N. R. Young, the old general superintendent, is retained and we wish to remark right here that the company could not have found a better man. He is thoroughly efficient in every branch of the telephone business.

The annual meeting of the New England Telephone and Telegraph Company was held in New York last Monday. The directors' report for the year showed that the gross earnings were $919,109, and the net earnings $259,413. Compared with the results in 1885 there was a decrease in the gross earnings of $1,732, a decrease in expenses of $37,328, and an increase in the net earnings of $35,596. During the year dividends were paid amounting to $210,000. The underground system has been considerably advanced, and during the present season the wires will be made continuous for a distance of 143,000 feet. The old board was re-elected, consisting of W. H. Forbes, Thomas Sherwin, Chas. P. Bowditch, T. N. Vail, of Boston; Henry S. Hyde, of Springfield; Frederick Ayer and Moses G. Parker, of Lowell; Stephen Salisbury, of Worcester; Benjamin C. Dean, of Manchester, N. H. Mr. Thomas Sherwin was re elected president; H. S. Hyde, vice-president; W. R. Driver, treasurer; and F. J. Boynton, secretary and auditor. The selection of a general manager, to fill the vacancy caused by the resignation of Mr. J. N. Keller, was left with the executive committee, consisting of Thomas Sherwin, T. N. Vail, W. H. Forbes, and Moses G. Farmer.

Telephonic News

Telephonic Woes.

BY A VICTIM.

You here behold a sorrowing soul
With feeble health and tottering knee.
The cause I'll plainly state in brief
If you but listen unto me.
When "canvassed" by a cunning fiend
Who crushed my happy household throne,
An hour of weakness o'er me came—
I signed, and leased a telephone.

But I sorrow to say
That I'm rueing the day.
Ever "crossed" or "cut out,"
I may whisper or shout;
I have nothing but woe to record, ah!
What with humming and ringing,
And crying and singing,
My telephone's never in order.

At dead of night while baby slept
Its fearful, clanging, warning dire
Waked all the household with affright;
Of course we thought the house on fire.
As usual, 'twas a false alarm—
I'm pleased to think it was no worse—
An anxious father called me up
To come at once his wife to nurse.

And that's why I say, etc.

And once, when sudden illness came,
Our doctor at his home I called.
'Twas full an hour ere he replied,
And then "I'll come at once," he bawled.
The door bell rang, he broke the wire;
I stumbled down, I know not how;
A vile horse doctor lumbered in,
With "What's de matter wid yer cow?"

And that's why I say, etc.

My butcher sends me ham for lamb,
And geese for peas my grocer brings;
Potatoes with tomatoes mix,
And teething rings are corset strings.
White vinegar wife ordered once,
The grocer's boy gave back the laugh,
And said, "White niggers can't be had;
The best are only half and half."

And that's why, etc.

To-day down-town my Jane I called
To ask about our baby child;
The sparks flew fast and words were hot—
I really thought my wife gone wild.
Oh! dire mishap! these tattered sleeves,
This lovely eye, this brain on fire,
Have culminated since I kissed
My wife upon another's wire.

And that's why, etc.

And like my clothes, my soul is rent,
My peace on earth is ended quite;
I tremble through the daylight hours;
I dream of demons fierce at night.
Oh! for an expert skilled and true!
Is there no Bell or Gray about,
Who'll fix the brawling, noisy thing,
Or, failing this, will take it out?

You see why I say, etc.

⁂ Telephoning between New York and Philadelphia is now as easy as it was between points about a block apart a few years ago.

⁂ The National Improved Pan-Electric Telephone Company, of Chicago, has increased its capital stock from $10,000 to $3,000,000. This is somewhat of an increase for a beginning.

⁂ Among the passengers on the steamer San Pablo, which sailed last week for Hong Kong, were Count Eugene Stanehlaw Mitkilaiz, an electrician, of Washington; S. A. Hern, a capitalist, of Philadelphia, and E. T. Barberie, of New York. They represent the syndicate to which the Chinese Government has granted the exclusive privilege of using the telephone in China for 30 years.

⁂ The microphone is now being used in Germany for the purpose of detecting loss of water through leakage in town mains. The apparatus consists of a steel rod, which is placed upon the cock in the neighborhood of which the leak is suspected, and a microphone attached to the upper end of the rod. A dry battery and a telephone completes the equipment. No sound is heard in the telephone if the cocks are closed and no leak occurs; but a leak even of a few drops through a badly-fitting cock causes sufficient vibration in the pipe to affect the microphone, and give audible sounds in the telephone. At a recent meeting of gas and water engineers, in Eisenach, it is stated that the apparatus is so simple to handle that, with a little practice, ordinary workmen are able to detect and localize any leak.

A Sweet Telephone Voice.

A very pretty wedding was solemnized at the Cathedral yesterday morning, when Miss Cora M. Finch became Mrs. J. Edward Smith, and the finishing chapter of a delightful little romance was written. The bride is a Cincinnati girl, who, owing to financial reverses, went to Kansas City several years ago and became a telephone operator. The groom is a merchant of good standing in Kansas City. While attending to his business he was attracted by the sweet voice of the girl operator, and the impression was so deep that he sought her out and secured an introduction. The acquaintance, which had such a romantic beginning, opened into a warm friendship and then into love, and the wedding of yesterday was the happy result. It was the wish of Miss Finch that she be married among her old friends in Cincinnati. —*Cin. Enquirer.*

Telephoned Through His Body.

Last Saturday Nelson Crane moved the telephone at Creek Settlement from the grocery into John White's sitting room. Just before he took the wires out of the instrument he telephoned home to his sister, telling her to ring Lower Deposit and to talk with that station in about a minute after he spoke to her. The ring for Deposit is three short and one long. Mr. Crane then took the wires from the instrument and held them between the thumb and forefinger of each hand. At the appointed time he received three short shocks and one long one, severe but not painful. Soon after he could feel a very slight, pleasant, agreeable sensation in his fingers clear up to his elbows, and he concluded they were talking. He then put the wires back into the instrument for a moment, and found that his sister at home, a couple of miles distant, had rung Deposit and successfully held a conversation with that station, and it was all done through his body.—*Deposit Courier.*

Sea Telephony.

Mr. Henry Edmunds says he has read with interest our account of Mr. Edison's experiments with his sea telephone, and proceeds: "It may interest you to know that on February 12th, 1878, I took out a patent, No. 584, for an apparatus which I called the 'Aquaphone,' which essentially consisted of a submerged sounder, which could be actuated by means of a key operated either from a boat or on the shore. It was soon found that signals which were entirely inaudible in the air at a given range were distinctly audible under water, even at twice or three times the extreme limit of their range in air. After trying several kinds of receivers, the simplest was found to be a pine rod, with one end shaped like a paddle, immersed about three feet in the water, with the other end held close to the ear. Experiments were made in February, 1878, down below Greenwich, where an attendant in a boat (which was several times hidden from sight by intervening objects) received and transmitted signals readily, and acted in accordance with a pre-arranged code. The matter was then brought to the notice of the Trinity House, and of Sir James Douglass, that the experiments might be carried out on a larger scale, but he said that they had no funds at their disposal for that purpose, and could only consider the thing in its completed form. Again in 1879, off the Lancashire coast at Blackpool, I made fresh experiments in a very rough sea, and had no difficulty in making and receiving signals, provided the sounder and the receiver were sunk sufficiently deep below the surface of the waves Want of time and opportunity prevented further experiments in this interesting field, and therefore the matter has been in abeyance. I think, however, that a simple form of 'Aquaphone' could be attached to all vessels, and worked either electrically or mechanically. This would have several advantages for signaling purposes. It would not be interfered with by fog or external noises, nor by the nuisance that most fog signals are at present to landsmen within hearing of them."—*London Electrical Review.*

The Cables Under the Sea.

THEIR NUMBER AND COST, AND THE WORK THAT THEY ARE PUT TO

The first electrical signal ever transmitted between Europe and America passed over the Field submarine cable on Aug. 5, 1858, and set joy bells ringing and cannon firing in every town and city in this country then reached by telegraph. But the operation of the first cable was spasmodic at best. It was formally opened for business on Aug. 13, but its vitality steadily declined until Sept. 1, when its life went out, and never since has it been restored. It still lies submerged in the depths of the Atlantic, representing a loss to its enterprising projectors of $1,834,500. Great credit is given, and very properly so, to the gentlemen who invested their money in that enterprise, and in the popular estimation on this side of the Atlantic they are looked upon as adventurous pioneers in submarine telegraph construction.

But in this respect there is a general popular misunderstanding, remarks the N. Y. *Sun*. The first submarine cable—that across the English Channel from Dover to Calais—was laid in 1850, and from that time until the laying of the first Atlantic cable, in 1858, no less than fifty-two cables had been laid in various parts of the eastern hemisphere. But these were all comparatively short lines, and none of them was laid in greater depth than 1,500 fathoms. The longest of these lines was that from Sardinia to Malta, 500 miles; and the greatest depth of submersion was that of the line from Sardinia to Africa, 1,500 fathoms, and another from Sardinia to Bona, the same depth. The Atlantic cable was 2,036 miles in length, and was sunk in 2,400 fathoms of water. Thus, notwithstanding that the mere question of submarine telegraphing had been affirmatively determined, it was still so serious a question whether so long and so deep a cable would be successful, that it was with the greatest difficulty the necessary capital was secured for the undertaking, and only the untiring perseverance and unflagging faith in the enterprise of Cyrus W. Field overcame the scruples of conservative and phlegmatic Englishmen and secured their co-operation.

The disastrous failure of that first cable quite naturally dampened the ardor of its projectors, and it was not until seven years later, in 1865, that Mr. Field succeeded in securing financial backing for a second attempt, which, happily, proved successful; and since that time America has remained in uninterrupted telegraphic communication with the commercial world. To-day there are twelve cables stretching across the Atlantic, though but ten are in actual use. The first Field cable was abandoned when its conductivity first ceased. The second laid has also since been abandoned, its faulty construction and the frequent repairs rendered necessary in consequence, making a new cable cheaper than its maintenance. With its abandonment $3,000,000 was added to the wrong side of the profit and loss account of etablishing transatlantic telegraphing. That leaves ten cables now in actual operation, owned and controlled by several companies, as follows:

Anglo-American (Field Co)	4 cables
Western Union (Gould lines)	2 cables
Direct Lines	1 cable
Franco-American	1 cable
Commercial (Mackay-Bennett	2 cables

These various cables are practically grouped under three general managements:

First—The so-called pool lines, which work in harmony under a mutual agreement as to the division of business and earnings. This pool originally embraced all but the Commercial or Mackay-Benett cables; but the French company has recently given notice of its intention to withdraw from the pool, because of dissatisfaction with the low rate (twelve cents a word) fixed by the pool managers in their present fight with the Commercial Company.

Second—The Commercial Company or Mackay-Bennett cables. This company started in business with a tariff of forty cents a word, and refused to unite with the others in a general pool of the business and the establishment of a sixty-cent tariff; whereupon the other companies unitedly declared war, and reduced their rates to 12½ cents a word. The Commercial Company responded by reducing its rate to twenty-five cents, announcing that it preferred doing no business at all to doing it at an actual loss, and that twenty-five cents would only about pay expenses. It also promised its patrons that if they sustained it in the struggle it would never advance its rates beyond forty cents a word.

Third—The Anglo-French Company, which owns two cables, one of which, however, is leased to the Western Union, leaving but one under its control. That one has hitherto been operated in harmony with the pool, but the proprietors are dissatisfied with the low competing rate fixed, and have given notice of their withdrawal from the combination. It is not known whether they intend to unite with the Commercial Company, or will undertake to maintain an independent rate of their own, such as they may consider remunerative.

The amount of capital actually now invested in transatlantic cables is estimated by cable men at from $70,000,000 to $75,00,000, on which, they declare, they are not only not paying any dividends, but are in reality losing money by reason of the existing brisk competition. It is not easy to ascertain what would be a fair-paying rate for the transmission of messages over these cables. Of course the first cost of the cables is enormous, many times greater than that of an ordinary land line. Then the cost of maintenance is an uncertain item, large at best. Breaks are constantly occurring, and their repair is a matter of thousands of dollars. One of the French cables was out of order a couple of weeks ago, and one of the Field cables recently parted. In all such cases the services of a steamship are required; the two ends have to be fished for, brought to the surface, and spliced, all of which is expensive business. Again, the operating expenses are greater than those of land lines. The cables mostly terminate at out-of-the-way points on either coast, frequently far removed from any settlement. Of course, operators will not immure themselves in such localities except under the inducement of extra compensation. Then, in addition, houses must be built and furnished for their accommodation; provisions and all manner of supplies transported to them, and to minister to their contentment libraries, billiard tables and other means for their diversion and relaxation are provided. Finally, the conductive capacity of a long cable is greatly below that of a land line, where relays are possible at intervals. The manager of the Direct Lines Company said that the cables do not average sixteen words a minute, and that when pressed they do not do as well as when worked more leisurely. He explained that with steady work a cable gets electrically clogged, and works badly; while if allowed to lie idle for awhile it becomes fresh and capable of doing its full duty.

Thus, then, it must be apparent that the business of transatlantic telegraphy cannot be judged by the standard of land telegraph lines. Nor are all the elements which should enter into a fair estimate of the cost of transmission even mentioned above. Mr. Brown, General Superintendent of the Direct and French lines in this city, very kindly furnished the reporter with some points that enter into the consideration. Thus he says that not any of the cables are occupied to their full capacity except for about 3½ hours out of the twenty-four during which the commercial Exchanges of Europe and America are in simultaneous session. The pressure of business begins at about 10 A. M., New York time, and ends at 1½ P. M., when all business throughout Europe has ceased. From 5 A. M. until 9 P. M. there is a fair amount of business, but in the early and later hours, before and after the Exchanges close, it is nothing like the capacity of the cables to dispose of. After 9 o'clock at night only press business is offered, and that is through with usually by 1½ A. M., leaving the cables absolutely idle from that time until morning. Mr. Brown's estimate is that none of the cables yet has an average of

sixteen words a minute for transmission, which would be 960 words an hour, while he places their average capacity at 1,800 words an hour.

Asked as to the possibility of a reduction below the present lowest rate (12½ cents a word) Mr. Brown said that it would be actually impossible unless the first cost of the cables could be very materially reduced, and the cost of maintenance and operation correspondingly so. The Direct lines lease land lines in England over which they transmit their cable business; the rental of those lines and the cost of their operation consume several cents of the present cable charge. Then on messages to France and Germany they are required to pay to the Governments of those countries, which own their telegraph systems, three cents a word for transmission. These figures make no account of the cost of land transmission on this side the ocean, which is something to each company.

Mr. George G. Ward, Secretary and General Manager of the Commercial Company, was more conservative in his estimates than Mr. Brown.

"What is the actual capacity of a single transatlantic cable?"

"The average Atlantic cable is capable of transmitting 100 letters a minute; and, taking eight letters as the average length of a word, we get 12½ ordinary words per minute, 720 per hour, or a total of 18,000 words per day of twenty-four hours. Allowing for preambles, corrections, and repetitions of doubtful signals, etc., call 15,000 words a day's work for a single cable worked continuously throughout the twenty four hours."

"How many words is it possible for the best cable to transmit in a minute?"

"The best cables, such as the Mackay-Bennett Company own, those of the latest construction, embracing every new improvement, would surpass somewhat the figures already given; but those figures are a fair average."

"At what hours is the greatest pressure of business experienced?"

"The time of greatest pressure on the cables is when the New York and London Stock Exchanges, and other European and American marts for cotton, coffee, produce, and metals are simultaneously in session. The five hours or more difference in time between the two continents limits the duration of operation on the Exchanges to about three hours—say from 10 A. M. to 1 P. M., New York time."

"Which are the more profligate users of the cable, the English or American merchants?"

"America sends more cablegrams to Europe than Europe sends to America. The percentage of difference I have not estimated."

"How much capital is now invested in cables under the Atlantic?"

"Approximately $72,000,000."

"What dividends have the cables earned?"

"Previous to the present rate war the Anglo were earning at the rate of 3 per cent., and the Direct and French lines each about 5 per cent."

"Why were the Mackay-Bennett cables laid?"

"They were undertaken purely as a business enterprise, based upon the belief that the cabling public would support a well-equipped, independent, and competitive system, which would tax them a reasonable rate for its services, with no exactions for watered capital. The sequel of events has justified the convictions of the projectors."

"Do they get business enough?"

"The company is receiving a steady support from the anti-monopoly business houses of Europe and America. Aside from the principles involved, this support is maintained and strengthened by the superior swiftness and trustworthiness of its service in comparison with other routes. This advantage is derived from its all-cable route from New York city—it being the only company having a cable leading directly into this city—and to its excellent appointments."

"What rebate has it promised to regular customers in the event of its lowering its prices below the present rates?"

"None whatever. The company adopted a no-rebate policy from the start. No person is favored to the disadvantage of another. Its motto, in brief, is 'Equal service to all; exclusive privileges to none.' At the inception of the attempt to force it from the field of competition by ruinous rates, it reduced its tariff to twenty-five cents per word, and guaranteed its supporters that in the event of its being compelled to raise rates by reason of being defeated in the tariff fight to a point exceeding the forty cents per word rate with which it started business, it would refund the difference between its fighting rate of twenty-five cents and that of the opposition companies' fifteen and twelve and a half cents rates."

"If a uniform rate of two and a half cents a word were established on all cables, what business would be taken from the mails?"

"The effect of a reduction of the cable rate to two and a half cents a word upon correspondence sent by mail is problematical. It is safe to hazard the opinion that social correspondence sent by mail would not be so very largely affected. A telegram sent in plain language has the disadvantage of the postal card, in so far as its contents can be known to a third party. When it is 'coded,' or in cipher, there is the trouble of 'undoing' it and the further annoyance of errors that frequently make it unintelligible. Two words sent by cable at a two and a half cent rate would equal the price of a half ounce letter, which, on the price of a half ounce letter, which, on the other hand, could contain thousands of words. There would doubtless be an enormously increased use of the cables by business men, who might even adopt this way of distributing their circulars, business announcements, etc. The experience derived from reductions thus far, however, is that the amount of business does not increase commensurately with the reduction of tariff. A fifty per cent. reduction of tariff will not be followed immediately, if at all, by a hundred per cent. increase in the amount of business done. It should also be borne in mind that out of the tariff the cable companies receive they have to pay the charges for further transmission of messages beyond their cable landings in Europe. Then there are such stubborn facts as reserve funds to be maintained, and it is assuredly no trifle to pay for cable breaks. Heaping all these things together, and using them as a vantage ground, we cannot, with even the aid of the best telescope extant, see the establishment of such a rate as a permanent and fixed fact, unless, indeed, the whole of the construction, laying, equipping and maintaining of submarine cables, and more especially and above all, the method of transmitting messages, is rapidly and entirely changed."

How much money could the Mackay-Bennett cables earn at 2½ cents a word, working to their full capacity?"

"I can only refer you to the figures given in answer to your first question, and you must bear in mind that the Mackay-Bennett cables, if duplexed, are equal to four single cables. You can make your own calculations."

"What is 'duplexing' a cable?"

"It is enabling it to convey messages both ways at the same time."

"What is the siphon recorder?"

"The siphon recorder is an instrument which records or registers the signals received over a cable. Originally these signals were received by the shifting flashes of a mirror, which were by carefully trained operators translated into letters and words. But Sir William Thomson has since invented a recorder which registers the signal, which has been improved upon in turn by Mr. Chas. Cuttriss, chief electrician of the Commercial Cable Company."

"What are your views on the present cable war—its duration and outcome?"

"The cable war was brought about by the attempts of the associated or pool companies to force the Commercial Company to increase the rate at which it wanted to do business (40 cents) by from 49 to 50 per cent. Championing the cause of reasonable cable rates, the Commercial Company resolutely refused to advance its tariff to the desired point, whereupon the pool immediately reduced their rates to 12½ cents, with the object of starving the Commercial Company into submission. The Commercial Company, however, declined to meet this ruinous cut to its full extent, and, being fully convinced that the public saw clearly the meaning and object of the pool reduction, it offered them a rate of twenty-five cents per word, at which point it reckoned, if well supported, it could pay its running expenses, not, of course, including breakages of its cables. The responses met with justified the measures taken, and just as long as the public care to maintain its champion, so long will it fight their battle."

There are now in operation throughout the world, as nearly as can be ascertained, about 100,000 miles of submarine cables, representing a total capital of $175,000,000. Of these the Atlantic cables are the longest and the most costly, and are maintained and operated at the heaviest expense. Yet, owing to the competition existing between the Atlantic companies, a message may be sent hence to England for 12½ cents a word, while it costs from $2.52 to $2.76 a word to communicate with Cuba and the West India Islands; from $2 to $4 a word to South America; from $1 to $1.80 from England to India; from $2.05 to $2.45 from England to China, and from $1.90 to $2.25 from England to South Africa.

The following table of cable rates will be interesting to all having occasion to use that means of communication:

FROM NEW YORK TO	A WORD.
England (pool lines)	$ 12½
Germany (pool lines)	15
France (pool lines)	15
England, France or Germany (Mackay-Bennett lines)	25
Nicaragua	2 52
Mexico	2 76
Havana	44
Jamaica	1 35
Porto Rico	2 08
Gaudaloupe	2 51
Martinique	2 60
Trinidad	2 96
Panama	97
Callao	1 72
Lima	1 72
Valparaiso	2 47
Buenos Ayres	2 15
Rio de Janeiro	2 55

The following are in addition to the rate to London by Atlantic cable:

FROM NEW YORK TO	A WORD.
Austria	$ 11
Belgium	06
Bulgaria	14
Denmark	10
Gibraltar	18
Greece	16
Holland	08
Hungary	11
Italy	09
Norway	10
Portugal	15
Roumania	12
Russia, in Europe	18
Russia, in Caucasus	25
Spain	15
Sweden	14
Switzerland	06
Turkey, in Europe	14
Philippine Islands	2 45
Alexandria	34
South Africa	2 15
Aden	93
Burmah	1 30
Ceylon	1 25
China	2 45
Corea	3 38
Japan	3 00
Java	1 70
Persia	1 00
Russia, in Asia	40
Siam	1 90
Singapore	1 58
Turkey, in Asia	43
Australia, via Eastern	2 65
Australia, via Siberia	4 05
New Zealand	2 90

—— General Manager McDonald, of the Ft. Wayne Jenney Company, has just closed a contract for 200 arc lights to be placed on the lower end of Coney Island.

—— There was insurance to the amount of $40,000 on the works of the Brush Electric Light Company, of Cincinnati, which were destroyed by fire last week.

Underground Wires in Buffalo.

The following are the grant and the restrictions as they left the hands of the Buffalo City Council.

That permission be and is hereby granted to the Bell Telephone Company of Buffalo to lay and maintain underground conduits, cables and wires, and construct the necessary manholes and make use of the connections in and through all of the public streets and alleys of the city of Buffalo, provided:

First—That nothing contained in this ordinance shall be construed to grant unto the said Bell Telephone Company of Buffalo an exclusive right or to prevent the grant of similar privileges to other individuals or companies for like purposes.

Second—That the Bell Telephone Company of Buffalo shall construct within eight months from the passage of this ordinance two miles of underground conduit, and the same shall be constructed with express reference to carrying the wires on Main street and Washington street from Exchange street to Chippewa street, and on Seneca street from Pearl street to Michigan street, and shall construct not less than two miles within one year thereafter, and bury the wires in such localities as the common council may designate; otherwise all right to construct any such additional conduit under the provisions of this grant shall cease and be forfeited.

Third—That before constructing any portion of the work hereby authorized the company shall file with the city engineer a plan showing the location and character of the proposed work, and all such work shall be performed under the supervision of such officer or department of the city government as shall have charge of the street, and such officer or department shall, if it be deemed necessary, at the expense of the company, appoint an inspector to supervise the work of construction.

Fourth—That in every underground conduit constructed by the company sufficient and necessary space shall be reserved, free of expense, for the use of the fire department, the police telegraph and telephone wires belonging to the city.

Fifth—That the Bell Telephone Company shall construct its underground conduits of sufficient capacity to carry all the present electrical wires of other companies and its own wires, and provide for an increase of such wires to at least 33⅓ per cent. of all such wires at present in use, except the electric light wires, upon such terms and conditions as may be agreed upon by the parties, or as may be determined by arbitration, as follows, viz.:

The said Bell Telephone Company shall designate one arbitrator, any electrical company desiring the use of any conduit to appoint another, and these two to designate a third; and in case the parties in interest cannot or do not agree upon such arbitrator within thirty days after application for such use, the mayor shall appoint some disinterested citizen and taxpayer such third arbitrator, and the decision of the majority of such arbitrators as to the terms and conditions of using the conduits shall be obligatory upon both parties, and shall constitute the terms and conditions upon which such applying company other than the electric light company, shall enter, use and occupy said conduits

Sixth—That the company shall remove its poles, lines and overhead wires whenever and so far as after a reasonable trial it finds that they have been satisfactorily replaced by underground wires, but nothing herein shall be construed to prohibit the city of Buffalo at any time from taking such action as under the law it now has the right to take, to compel the said company to remove its telephone wires, poles, lines and overhead wires from the streets wherein such poles, lines and wires are now placed.

Seventh—That before exercising any of the privileges granted by this ordinance the company shall file a bond in the sum of $20,000, with two sureties to be approved by the mayor, conditioned that it will properly relay and repave all openings made by it, and thereafter keep in repair for a period of three years the paving over said openings, and that it will assume and pay all damages for personal and other injuries that may occur, either to private individuals, corporations, as well as to the city of Buffalo, resulting from or accruing out of any negligence or want of care on the part of said company in the construction of any of its conduits as herein provided for, or in the repair and maintenance of the same, and that it will preserve harmless the city of Buffalo from any liability or expense which may be placed upon it, or for which it may be made liable for any injury resulting from such negligence on the part of the company aforesaid.

Written for the ELECTRICAL REVIEW.

Carrying Capacity of Wires.

BY F. B. BADT.

"What is the safe carrying capacity of these copper wires?" is a query which every day stares the practical electrical engineer in the face, and which, in the end, 999 times out of 1,000, he is inevitably compelled to answer from the storehouse of his own practical experience, so widely at variance are authorities upon this very important point. With all this dissimilarity of requirements, is it any wonder that we find installations of electric light plants in which even the crude and primitive rule of the National Board of Fire Underwriters is disregarded and wires do become painfully hot?

That law tells us that "the safe carrying capacity of a wire is that current which it will carry without becoming painfully warm when grasped in the closed hand."

As this rule does not specify whether the temperature of the air shall be 50° F. below zero, or 120° above in the shade, and does not designate whether the closed hand shall be that of a horny-fisted lineman or that soft palm of an electric light agent, there is, with this leeway of near 200° F., a sufficient margin to easily satisfy the most fastidious or uncertain constructor or inspector; and both classes have repeatedly been thus accommodated all over the union.

Repeated attempts have been made by scientists and practical electricians to narrow down these limits and the following table shows how nearly these approach uniformity while adding to the perplexity of the constructor and engineer.

Let us examine the rule of the English Board of Trade, which is nearly the only authority for assuming a safe carrying capacity of three amperes per square millimeter section. In the table given this figure is nowhere else reached—save in one instance—and all the other authorities quoted agree that this amount of current cannot be safely carried in the larger conductors.

Now, we know that the conductivity of copper will vary more or less, but we will assume that in all cases we are using a wire of 96 per cent. purity.

The following table shows the rise of temperature in copper wires carrying three amperes per square millimeter calculated from this empirical formula.

TABLE I.

Authority.	Amperes per Sq. Millimeter Section.
English Board of Trade	3
Sir Wm. Siemens	2.8
W. Smith	2.7
Conseil Municipal de Paris	2
Fleeming Jenkin	1.8
Jamieson	1.5
Ormiston	1 3
Sir Wm. Thomson	.6
Underwriters (Sweden), arc.	2
" " incandescent, up to 50 lamps.	3
" " " 100 "	2.5
" " " 300 "	2

While not mathematically exact, the above results coincide nearly enough with a recent series of practical experiments and measurements in this direction.

Table II shows at a glance that the larger wires must necessarily become unsafely heated. For instance, a No. 0 wire, carrying three amperes per square millimeter in a heated engine room, or in an outside temperature of about 100° F., if made of the best copper, would show about 168° F.

But if we were to substitute copper of say about 80 per cent. conductivity, or a portion of the conductor has a sharp bend, an elbow, or a twist, by which condition it has lost part of its conductivity, it would not only become painfully warm, but intolerably hot, and blister the hand that grasps it.

And again, a glance at the table shows that the increase of temperature is proportionally greater in larger than in smaller conductors, which at once suggests that while some universal rule is asked for this one fails of general application.

What is needed is some law which will make the ratio between the heating effect of the current and the cooling surface of the conductor a constant.

The Swedish rule, in this regard, is by far the best.

Table III assumes the safe carrying capacity of a wire to be such as will convey a given current without an appreciation of temperature above 10° C. or 18° F., in excess of that of the surrounding atmosphere.

Prof. H. S. Carhart, of the Michigan University, at Ann Arbor, and E. J. Cowling Welch, C. E., M. I. M. E. of England, have calculated their tables on this basis, and their results coincide quite nearly with my own.

For the convenience of those who may desire to apply other rules, as given in Table I, I append the cross-section of conductors in square millimeters.

TABLE III.

B. & S.	Sec. Area. sq. mm.	Wire Heated to 10° C. or 18° F. Above Temperature of Surrounding Air.
		Current in Amperes.
0000	107.219	130
000	85.028	130
00	67.431	110
0	53.504	95
1	42.409	80
2	33.632	65
3	26.670	55
4	21.151	50
5	16.773	40
6	13.301	35
7	10.548	30
8	8.366	25
9	6.635	20
10	5.260	17
11	4.172	14
12	3.309	12
13	2.618	10
14	2.081	8
15	1.650	7
16	1.309	6
17	1.038	5
18	.8230	4
19	.6346	3
20	.5176	3

In conclusion, one word of warning to persons using tables for incandescent wiring which only refer to proper resistances of wires for certain distances and a given number of lamps, with a stated percentage of loss of energy.

Such tables do not take into consideration the safe carrying capacity of the conductor at all, and a less distance or a greater loss of energy may result in the innocent use of a much smaller conductor than any of the quoted authorities would permit.

To cover the case, I propose the following

RULE.

Ascertain the proper size of wire according to allowable loss, number of lamps and distance, and ascertain if this wire has the necessary carrying capacity. If not, then calculate for a smaller per cent. of loss, so that the wire will answer all the requirements.

Not infrequently the substitution of a strand of smaller wires for one large wire, though only its equal in cross section, will, according to the above table, increase the carrying capacity quite sufficiently.

TABLE II.

Rise in temperature above that of the atmosphere in degrees $C = \frac{c^2}{d^3} \times .000826$

c = current in amperes. .000826 a constant

d = diameter in centimeters.

Brown & Sharpe.	Rise Above Temperature of the Atmosphere.		Brown & Sharpe.	Rise Above Temperature of the Atmosphere.	
Gauge.	Centigrade.	Fahrenheit.	Gauge.	Centigrade.	Fahrenheit.
0000	54	97.2	11	10 5	18.9
000	48	86.4	12	9.5	17.1
00	43	77.4	13	8.5	15.3
0	38	68 4	14	7.5	13.5
1	34	61.2	15	6.5	11.7
2	30	54	16	5.8	10.4
3	27	48.6	17	5.2	9.4
4	24	43.2	18	4.6	8.3
5	21	37.8	19	4.1	7.4
6	19	34.2	20	3.7	6.7
7	17	30.6	..	..	..
8	15	27	..	..	..
9	13.5	24.3	..	..	..
10	12	21.6	..	..	..

Don't Write "Rush" on a Telegram.

OPERATORS RESENT IT, AND IT IS A GREAT HANDICAP ON A MESSAGE.

Never write "rush" across the face of a telegram. If you do, you will retard rather than accelerate its dispatch. Employes of telegraph offices pay no more attention to a message with such an inscription on it than post office men do to letters marked on the envelope, "In haste," "Very important; forward as soon as possible," "Deliver immediately," and with other phrases of like import.

"I always smile," said a retired operator, "when I think of the way we boys used to treat 'rush' messages in the Western Union office. Some blooming jay would come in and want a dispatch shoved through in a hurry. He would write 'Rush' across its face, thinking that would help it along. Now, the idea of such a thing! Just as if everything wasn't rushed in a telegraph office—that is, if left to itself. The boys look upon anything like that almost as a personal affront. What is the consequence? The receiving clerk takes the message, frowns a little when the 'rush' comes to view, receives the money, says 'all right,' and the sender walks out complacently. Then the clerk picks up the dispatch again, looks it over slowly, toys with it, and smiles. Just here two or three other persons come in, and he lays aside the 'rush' to wait on them. Finally he takes up his little pile of messages, puts the 'rush' at the bottom, and hands the batch over to the record clerk. When the record clerk comes to the 'rush' message, he also smiles. As it is the last on his desk, he plays with it for a while, practices penmanship on it (does the Spencerian act, you know), takes his time in recording it—in fact, does everything but rush it. From the desk of the record clerk the messages are given to the operators by the file boy. He, too, has a great antipathy for 'rush' messages. If all the operators are not at leisure, he supplies those who are from the top of the pile, and sticks the rest on a hook. If there is a 'rush' in the lot, it always goes on the hook. The upshot of the whole matter is that this precious piece of paper, with its immensely important communication, which the sender wanted 'rushed,' is about the last dispatch sent out."

Electric Lights for a Bull Fight.

A special from the City of Mexico says: The novelty of a bull fight by electric light drew an immense crowd to the Colon Plaza. Among the spectators were President Diaz and several members of his cabinet. The arena was brilliantly lighted by ten electric lights, and the gaudy uniforms of the matadors fairly blazed. The door of the bull pen was thrown open, and the first bull made a frantic rush at the picadors and in a minute was master of the arena, having killed one horse and gored two others. One matador and a picador were laid out, though not killed. The fighters became very timid, and plied the sword from the side, being afraid to face the animal as is usual. Of five bulls every one was desperate in the blazing light, and horses and fighters were rolled over and tossed in a terrible manner. One swordsman attempted to kill the bull as he charged, and was caught on the horns and tossed out of the arena almost lifeless. The result of the fight was four horses killed, several torn and crippled, two matadors nearly killed and several picadors disabled. The dazzling light seems to make the animals wild. This was the first time bull fighting had been tried by electric light.

An Electric Club Guest rises to Remark.

To the Editor of Electrical Review:

You were expecting to hear from me. Excuse the delay which has been caused by the accidental collision of my head with an "Electric Club" in which both must have suffered somewhat. I received some impressions during the struggle and will endeavor to state them briefly. I attended the "election" and stayed until after dinner.

My first impression after reaching the hotel with the profane suffix was that I had made a mistake in omitting to slip into my "swallow tail" and white cravat before leaving "ohm," but luckily I had my swallow with me, and a very useful bird he proved.

We have all heard that "one 'swallow' does not make a summer," but why the flock of them that I captured that evening has not improved the temperature of our backward spring is something I cannot account for.

My carelessness in the matter of costume did not seem to be noticed and I was invited to vote. I voted repeatedly and observed that the person in charge of the polls invariably handed one ticket back to some one of the party—some little informality about his naturalization papers I presume.

Permit me to heartily congratulate the gentlemen elected and to assure them one and all that I did what I could for them.

It struck me, as the party "filed" in for dinner, that it was "Rothery" good looking crowd.

(Note. The "connections" of this elaborate joke will be explained "to members only" on receipt of a one cent stamp). But I am sure the reporter for the REVIEW must be mistaken as to the number present. He may have counted right as we went in, but an hour later if there were not at least 500 "electricians" in that room and more coming every minute "may I never see the back of my neck."

I was given a very eligible seat at the corner of a table which left my right elbow free (a delicate compliment which was appreciated) and worked my way slowly but firmly through the "menu." I do not often have the pleasure of dining to such music, and might have overeaten but for the necessity of economizing space for the toasts. My right hand neighbor must have taken me for the representative of "Mark Twain's" initials. I brought away with me an abiding conviction that he must be a lineal descendant of King Phill-up, for although my bird attended strictly to business the glass never got empty. The "Poles" we took down! ("dry mono" I think is the adjective?) ought to make us solid with the "Subway" commission for all time.

Ehue! Well, as I have heard remarked of certain cricket players, "I carried my 'bat' out" and reached my rural retreat next day in fine order. Found a brass band at the door of our principal hotel waiting to receive me, and upon apologizing to the landlord for putting him to so much trouble and expense on my account, was surprised to learn that they were advertising a ten-cent show.

Have spent most of my spare time since in trying to "take out a cross" between Mr. Hine's poem and Mr. Wilder's "Telephone" story, which somehow get inextricably mixed in my memory.

May the "Electric Club" flourish, no matter whose head it hits.

Yours gratefully,

JACK SELDEN.

MATTEAWAN, N. Y., April 30, 1887.

*** The Standard Underground Cable Company celebrates its removal into new and commodious offices in the Telephone building on Cortlandt street, New York city, by closing a sale with the Western Union Telegraph Company that greatly pleases the cable company, and is a source of much gratification to the energetic New York manager, Mr. Geo. L. Wiley, who made the sale. 19,100 feet of thirty-conductor No. 14 wire cable was purchased to be used in the Western Union's conduit, and 10 miles of nineteen-conductor No. 14 wire cable to be used on the elevated railroad structures. The order is a big one, and is taken as an indication that the Western Union intends to enlarge and improve its facilities in New York city at once.

Narrow Escape of a Distinguished Electrical Party.

The safe arrival of Mr. T. A. Edison, Mr. E. T. Gilliland and the other members of their party in this city May 1st, was the occasion of their receiving numerous congratulations over their very narrow escape from drowning last Thursday, April 28. The entire party of eight persons were standing on a pier at Kissimmee Springs, two miles from Barlow, in Florida, when the pier collapsed and precipitated all the party except Mr. Edison and Mrs. Gilliland, of Adrian, Mich, into the water, which was eight or ten feet deep.

A number of residents who saw the accident rushed to the scene and saved those imperiled. Several of them were going down for the third time. Those in the water were: E. T. Gilliland and wife, and Charles Ward and wife, of New York; Miss Daisy Gaston, of Indianapolis, and Miss Louise Miller, of Akron, O. Mr. Edison and Mrs. Gilliland only saved themselves by lucky leaps to *terra firma* from the breaking timbers, being nearer land than the others.

Had it not been for the prompt action of the rescuers, a very different and much sadder report would have to be made of the incident; as it was, save the unpleasantness of thorough drenchings, the party completed their Florida stay, and arrived in New York three days later, feeling none the worse for the perilous experience they met with, so near the close of a very enjoyable winter sojourn in the South.

Lighting of a French Yacht—A Singular Installation.

The yacht "Isle de Jersey," of Cherbourg, has recently been fitted with an installation of electric light, consisting of one projector of 1,000 carcels, 200 Gimé incandescent lamps, of 25 candle-power, and two of 100 candle-power each, the latter being used for the side lights. Some description of the Gimé lamp, which is a new and interesting type, will be found in another column. The dynamos are made by Ackermann, and are driven by a couple of high-speed "Farrey" engines of 25 horse power. The machines give 900 volts at their terminals, and the 200 lamps are divided into 20 separate circuits, 10 lamps being connected in series upon each. When the projector is brought into use it is necessary to employ both dynamos together, and only 100 incandescents can then be run at the same time. Altogether, it will be seen that this is an installation of quite a remarkable character, and differs very widely from the ordinary run of ship lighting installations, or jobs, as a friend of ours prefers to call them. It is a little difficult, perhaps, to understand what can have been the motive which has led to the use of a multiple series high tension system (especially with lamps of 90 volts) within the narrow limits of a yacht. We are inclined, moreover, to think that, not merely in this case, but in the majority of ship lighting jobs, a mistake has been made in using lamps of such high candle-power. In the saloon the candle-power to be used is chiefly a matter of taste, and will make little or no difference in the cost of the installation; but for the cabins, or state-rooms as they are called on the liners, lamps of 10 candle power are amply sufficient. Some time ago, when (following the precedent of oil lighting days) it was customary to place the switch outside, leaving the inmate of the cabin entirely at the mercy of the stewards in the matter of light; it was also a frequent arrangement to provide a single lamp between every two adjacent state rooms. It is now found perfectly safe to place the switch at the disposal of the passenger, and the latter would in all probability find no ground for complaint if he were provided with a cabin lamp of half the usual candle power.

The New England Telephone and Telegraph Company has declared a dividend of 75 cents per share, payable May 16, to stockholders of record May 4. Transfer books closed May 5 and will reopen May 15.

The Mutual Electric Manufacturing Company, of Brooklyn.

This company found its business increasing so rapidly that new and much larger offices and factory were imperatively demanded, and on May 1st the large factory building at 292 to 296 Graham street, near DeKalb avenue, was taken possession of, and three floors will be occupied, as well as an addition now in course of construction. The Mutual Company will manufacture instruments of precision on an extensive scale, as well as continue the manufacture of the Knowles electric light system. One floor will be devoted to the manufacture of the Julien storage battery, in which the Mutual Accumulator Company has acquired a large interest. Both the storage battery and the manufacturing companies are under the direct management of Mr. Theo. Otis, president, and Mr. E. Knowles, superintendent and electrician. With their increased facilities, which will permit them to meet the ever increasing demand for good electrical work, the Mutual Company will undoubtedly reap a rich reward, and the REVIEW wish them the success that their enterprise deserves.

Electrolytic Polarization Produced by Small Electromotive Forces.

The polarization of platinum plates in dilute sulphuric acid was measured during the flow of the polarizing current, which was always so small as to produce no visible evolution of gases. Two forms of electrolytic cell were employed, the first open, containing two platinum electrodes in cells, joined by a tube containing a third, and a second form in which there were four equidistant electrodes contained in a glass tube. The acid employed varied in strength from 1 per cent. to 3 per cent., the amount of dilution not being found to produce any observable result. With the latter form of cell the two middle electrodes were joined to the battery through a variable resistance, the two outer plates being for the purpose of measuring the potentials of the others by connection with a quadrant electrometer. In the first set of experiments it was found that the maximum polarization had occurred by the time the electrometer could be read, and the difference of potential was nearly equal to that obtained by joining the battery directly to the electrometer. Experiments with the open voltameter led to the conclusion that the difference of potentials between the plates remained nearly constant from the instant of making the current, but that the polarization of the oxygen plate continuously increased, whilst that of the hydrogen plate decreased. In a voltameter free from air, the changes were similar, but in an opposite direction. The influence of a previous polarization of the electrodes was examined, the battery being joined first in the same direction, and secondly in the reverse direction to that of the former current, and also the effect of polarization of only one of the electrodes, this being effected by introducing temporarily a third electrode, and using it as an anode or cathode, as required. By raising an electrode gradually out of the liquid, the effect of change of area was examined, and it was found that if either anode or cathode were raised so as to lessen its area of immersion, its polarization was increased at the expense of the other. Many other experiments were made, but without leading to any general conclusions, the author intending to extend the investigation, using gold and silver electrodes.

Conversion of Heat into Electricity.

Herren Hurghausen and Nerust have discovered a direct mode of transforming heat into electricity. It consists in placing a thin slip of metal in a magnetic field and maintaining its two ends at different temperatures, when a difference of potential is found between the two opposite sides of the slip. The direction of the current is reversed by reversing the direction of the magnetic field. The effect is, however, very slight. With a square plate of bismuth, measuring 5 centimeters on each side and 2 millimeters thick, a field of force represented by 5,000 C.G.S. units, and a difference of temperature caused by placing a mica plate against two sides of the bismuth, one dipping in cold water and the other heated by a gas flame, the resulting difference of potential was only 0.00125 volts. With iron instead of bismuth the current is in the reverse direction.

—— Troy, N. Y., has contracted for it electric lights at forty-seven cents per night.

—— Detroit is advertising for electric light bids. All the details appear in our advertising columns, and are well worth careful perusal by all the electric lighting companies. As the bids are to be opened on the 11th of May, prompt action will be necessary on the part of all who intend to try to secure the contract.

—— The Gas Commission of New York last week awarded a contract to the United States Electric Light Company, at the rate of $182 50 per lamp per year. All the other bids were rejected, and at the suggestion of the Mayor new bids will be advertised for. The contract of the United States Company is for the district between Fourteenth and Canal streets.

—— At a meeting of the directors of the Brush Electric Light Company, of Buffalo, held at the office of the company last week, the following officers were elected: President, Daniel O'Day; vice-president, James Adams; secretary Wm. S. Frear; treasurer, John M. Brinker. The change in the presidency was made necessary by reason of the long-continued illness of Mr. John F. Moulton, which is deeply regretted by the company.

—— From the rapid strides being made now in electricity, it is evident that in a few years many street car lines will be run by this system. At the present time there are a number of places where electricity is used. The Kansas City Company are adding a second Ball engine for this purpose, and the Street Railway Company, of Binghamton, N. Y., is putting in a 13×12 Ball engine. Lake View, N. Y., is also to have their streets lighted by the Thomson-Houston system, run by two Ball engines.

—— The suits of the Edison Electric Light Company, of New York, against the Keystone Light Company, of Philadelphia, asking for an injunction because of infringements, and also for an accounting on account of claims for royalties, has created some little stir in electric light circles. The Philadelphia system is controlled by the Westinghouse syndicate, which also controls the Allegheny County plant, at Pittsburgh, and it is safe to infer that if the injunction should be granted against the Philadelphia concern, the same proceedings would be taken against the home company. This action is probably intended as a test suit.

—— An item in the Troy *Times* is as follows:

"A leak in the floor of the Western Union telegraph office, corner of Broadway and River street, allowed water to drip last evening upon wires leading to the electric light in William Ahern's saloon underneath. The contact of the water permitted the electricity to escape, and the ceiling in Ahern's place was ignited. Ahern seized a seltzer-bottle and prepared to give the flames an extinguisher. He was a surprised man, when, after having opened a stream from the seltzer-bottle upon the fire, he was violently thrown from the bench upon which he was standing. The glass of the bottle saved him from more severe handling. The stream of water had completed a circuit, and the shock was the result. Mr. Ahern has ceased to act as a bottle-holder in a fight with electricity, and will hereafter use a pail."

—— The National Feed Water Heater, manufactured by the National Pipe Bending Company, New Haven, Conn., is very extensively used in electric light stations. Among the electric light stations recently supplied with this heater are, the Pittsburgh Electric Light Company, Pittsburgh, Pa., 600 horse power; Parkersburg Electric Light Company, Parkersburg, West Va., 200 horse power; Easton Electric Light Company, Easton, Md., 150 horse power; Rochester, Minn., Station, 150 horse power; Brush Electric Light Company, Savannah, Ga., 200 horse power; Edison Station, Boston, 500 horse power; Thomson-Houston Electric Light Company, Newark, N. J., 200 horse power; North Attleboro Steam and Electric Light Company, North Attleboro, Mass., 200 horse power; Meriden Electric Light Company, Meriden, Conn., 200 horse power; Gallatin Bank, New York, 150 horse power; Connecticut Electric Light Company, Waterbury, Conn., 300 horse power; Schuyler Electric Light Company, Danbury, Conn., 100 horse power; Citizens' Electric Light Company, Shenandoah, Pa., 80 horse power.

ELECTRIC LIGHT NEWS

—— The Piedmont Electric Light Company, Lynchburg, Va., will put in five additional 10 horse power dynamos for incandescent lighting.

—— Henry Mackey, a Detroit lineman, received a shock from an electric light wire, and fell from the pole to the ground, the fall fatally injuring him.

—— General Superintendent Weisleder, of the Cincinnati Electric Light Company, is reported as saying that it will take thirty days to start the lights in that city after the fire that entirely destroyed the station. Four years ago, April 24, the electric light company was burned out.

—— The Roanoke (Va.) Electric Light and Manufacturing Company has been organized, with Henry Fairfax, of Aldie, as president, and George R. W. Ames, of Philadelphia, Pa., secretary and treasurer. The capital stock is to be not less than $50,000 nor more than $1,000,000.

—— An Electric Light, Heat and Power Company has been organized at Gainesville, Texas, by J. T. Walker, E. A. Blanton, J. H. Andrews, B. S. Brooks, and C. C. Potter. The company purpose to generate electricity for light, heat and power. We wish them all success in the heating line, and are glad to see Texas coming to the front in this new line.

—— T. Wm. Harris, contracting engineer, of Boston, Mass., is putting up wrought-iron posts for the Harlem Electric Light Company; they are 4 inches in diameter at the bottom and 2¾ inches at the top. No objection to the posts is made by the property owners. These posts are well adapted for carrying the wires for electric railroads, being small and ornamental.

—— The organization of the Nyack (N. Y.) Electric Light and Power Company has been completed, and the villages of Nyack and South Nyack will be lighted with electricity by July 1. The following officers for the company have been chosen: President, Clarence Lexow; vice-president, Gen. James H. Blauvelt; treasurer, Charles A. Chapman; secretary, Harry G. Newton. The capital stock of the company is $20,000.

—— Wallace & Sons, of Ansonia, Conn., have sold their plant for the manufacture of carbons, and the good will of the business to E. C. Hawkes, trustee for the Carbon Manufacturers' Association, and will cease the manufacture of these goods. The machinery will be taken down and removed out of the State, to be set up either in Pittsburgh or Cleveland. Wallace & Sons will immediately occupy the building for the manufacture of fine wire, and give employment to a much larger force of workmen.

—— The Brooklyn Legislative Committee is still examining witnesses in regard to the electric lighting franchise in that city. Mr. H. W. Pope, of the former firm of Pope, Sewall & Co., testified that $4,250 was paid to Chief Nevins, of the fire department, to be used in securing the franchise for the Citizens Electric Light Company, and that a like amount was understood to have been paid by the Municipal Electric Light Company for the same purpose. This testimony had the effect of stirring up the electric light interests in the city of churches.

—— The Connecticut River railroad is experimenting with a system of lighting the cars by electricity generated by power taken from an axle of the baggage car. The difficulty in maintaining a uniform speed of the dynamo is sought to be overcome by a speed regulator. A sufficient amount of electricity is stored in each car to keep the lamps aglow during stops at stations, and the storage is replenished as soon as the train starts again. Automatic couplings are used and ten lights are to be set in each car and one on each platform.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING APRIL 26, 1887.

361,676 Electrical conductor; Leo Daft, Plainfield, N. J.

361,705 Binding device for electric apparatus; Isaac W. Litchfield, Warwick, assignor of one-half to Philip K. Dumaresq, New York, N. Y.

361,712 Regulator for dynamo-electric machines; 361,713, Fusible cut-out; Charles G. Perkins, Hartford, Ct.

361,730 Railway signaling; Shellman B. Stewart, Montclair, N. J.; and 361,731, Electric rope coupler.

361,734 Telegraphy; Francois Van Rysselberghe, Brussels, Belgium.

361,737 Magneto-electro telephonic call; George A. Wilkins, Philadelphia, Pa.

361,770 Electric inductive translator; William Main, Brooklyn, N. Y.

361,778 Electric valve operating mechanism for elevators; 361,779, Means for electrically controlling the operation of elevators; and 361,780, Electric valve operating mechanism for elevators; George H. Reynolds, New York, N. Y., assignor, by direct and mesne assignments, to the Crane Elevator Company, Chicago, Ill.

361,782 Gas and electric lamp fixture; James T. Robb, New York, N. Y.

361,794 Galvanic battery; Sydney F. Walker, Cardiff, England.

361,797 Switch and circuit for telegraphs; Stanton Weaver, Washington, D. C.

361,829 Electro-magnetic rock drill; Harry N. Marvin, Syracuse, N. Y.

361,843 Apparatus for distributing electrical power; 361,844, Safety device for incandescent lamps; Elmer A. Sperry, Chicago, Ill.

361,896 Armature core for dynamo-electric machines; Albert Schmid, Pittsburgh, Pa., assignor to the Westinghouse Electric Company, same place.

362,005 Electric Bell; Edgar W. Hazazer, New York, N. Y., assignor to Hazazer & Stanley, same place.

362,022 Apparatus for separating metals from ores or alloys by electrolysis; Henry Liepmann, London, county of Middlesex, England, assignor to the Cassel Gold Extracting Company, Limited, Glasgow, Scotland.

CONTROLLER'S OFFICE,
DETROIT April 28, 1887.

Proposals for Public Lighting.

Sealed proposals will be received at this office until Tuesday, May 10th, 1887, at 10 o'clock A. M., for lighting the city of Detroit for one, two or three years from July 1st, 1887, according to the following methods and specifications thereunder, respectively:

A.

To light the city with electricity by the tower and pole system, and the City Hall and Central Market buildings with electricity or with electricity and gas as at present lighted.

Specifications.

Electric lights to be furnished from not less than 122 iron towers located at substantially the same points as at present and carrying four hundred and eighty-nine arc lights, also one hundred and nineteen post arc lights at substantially the present locations. The City Hall and Market Buildings to be sufficiently lighted with incandescent electric lights of from 16 to 32 candle power each, number of lights to be within the discretion and to the satisfaction of the City Controller, or with the present number of arc lights and substantially the same amount of gas as required this current year.

All tower and pole lights are to be known in the market as standard 2,000 candle power lights.

Bidders to state at what price they will furnish any extra towers of four lights each, or any extra pole lights for the entire year, or any portion thereof, that may be ordered by the Common Council from time to time, and maintain the same.

The location of the above lamps will be found in the office of the City Controller.

The contractor to be at all expense for machinery, lamps, towers, lamp-posts, poles, wire and maintenance, and to care for and attend to lamps.

The towers to be not less than 150 feet in height.

Bidders are required to include in one bid the price to be paid for the entire service for one, two or three years under these specifications and not to bid separately for each item thereof.

B.

To light the city and the City Hall and Market Buildings with electricity by the incandescent system.

Specifications.

1. To light the territory bounded by Twelfth and Dequindre streets from the River to Fremont street and the lines of said street extending to Twelfth street with twenty-five candle power incandescent lights on posts. Four twenty-five candle power lights to be placed at street intersections, one at each corner and one twenty-five candle power lamp on each block on each side, providing at least one light every one hundred feet on line of street.

2. In addition thereto to light the territory not included in the above described limits being the outlying districts of the city with twenty-five candle power incandescent lights on posts. Two 25-candle power lamps to be placed at street intersections on diagonal corners thereof and one 25-candle power lamp in the middle of each block alternate sides of the streets between corners, providing at least one light every 150 feet on line of street.

The City Hall and Market Buildings to be sufficiently lighted with incandescent electric lights of from 10 to 25 candle power each, number of lights to be within the discretion and to the satisfaction of the Controller. The contractor to be allowed the privilege of utilizing present gas or naphtha posts if convenient.

The contractor to be at all expense for machinery, lamps, lamp-posts, poles, wire and maintenance, and to care for and attend to lamps.

Bidders are required to include in one bid the price to be paid for the entire service under these specifications for one, two or three years, and not to bid separately for each item thereof.

C.

To light the city and City Hall and Market buildings with electricity by the incandescent and arc, commonly called the municipal system.

Specifications.

1. To light all the territory bounded by Twelfth and Dequindre street from the river to Fremont street, and the lines of said street extending to Twelfth street with thirty-two candle power incandescent lights on posts. Two 32-candle power lamps to be placed at street intersections, on diagonal corners thereof, and one 32-candle power lamp in the middle of each block, alternate sides of the street.

2. In addition thereto, to light the territory not included in the above described limits, being the outlying districts of the city, with arc electric lights of 2,000-candle power each on posts. Posts 20 feet high and holding one 2,000-candle power lamp, to be placed on every other block of the above territory. The city hall and market buildings to be sufficiently lighted with incandescent electric lights of from 16 to 32-candle power each, and to the satisfaction of the City Controller.

Bidders to state at what price they will furnish any extra pole lights for the entire year or any portion thereof that may be ordered by the Common Council from time to time and maintain the same.

The contractor to be at all expense for machinery, lamps, lamp-posts, poles, wire, and maintain and to care for and to attend to lamps.

The contractor to be allowed the privilege of using present gas or naphtha posts if convenient.

Bidders are required to include in one bid the price to be paid for the entire service for one, two or three years under the above specifications and not to bid separately for each item thereof.

D.

To light the city adjacent to the gas mains, the City Hall and Central Market with gas.

Specifications.

Gas of not less than 16-candle power, burners not to be not less than 4 feet per hour. Lights to be furnished at substantially the same locations as those of the present lamp-posts, and to erect and maintain such additional number of posts and lamps as will equal the amount of

1,352 lights on the west side and

1,312 lights on the east side of Woodward avenue.

Also for City Hall and Central markets. Contractors to maintain light and extinguish, clean and care for the lamps. Contractors can use gas posts and lamps belonging to the city if convenient, but must furnish any additional posts and gas lamps at their own expense.

Bidders are required to specify the rate at which they will furnish any lights of the like character and quality which may be required by the Common Council, in addition to the above, from time to time.

E.

To light the city, not adjacent to the gas mains, with Electricity by the tower and pole system.

Specifications.

ELECTRICITY.

To light the territory not adjacent to the gas mains with 60 iron towers of not less than 150 feet high, and four arc lights each, and 43 posts of one arc light each, and located at suitable distances from each other, and to the satisfaction of the City Controller.

Contractor to be at all expense for machinery, lamps, towers, lamp-posts and poles, wires, maintenance and to take care of said lamps.

All tower and pole lights are to be known in the market as 2,000-candle power lights.

Bidders will state at what price they will furnish any extra lights that may be ordered by the Council from time to time, and maintain the same for the entire year or any portion thereof.

All lights under these several specifications are to be lighted from one-half hour after sunset until one hour before sunrise on every day of the year. And if from any cause any lights should not burn, the amount for such time as the lights are out shall be deducted from the monthly payments.

Bidders are required to file a satisfactory bond with the Controller before the proposals are opened, conditioned that on their being found to be successful builders, that they will enter into a contract, with good and sufficient sureties, to perform the work.

Proposals to be indorsed "Public Lighting."

The city reserves the right to reject any and all bids.

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BUSINESS NOTICE.

"In making the statements which follow we can verify each and all of them as facts. Mr. Edward P. Thompson, of Temple Court 7 Beekman St., New York, is a good man to bring your patent cases to, for he is thoroughly versed in all the ins and outs of a Patent Attorney's duties. The following are some of his qualifications: Graduate of Stevens Institute as Mechanical Engineer. For four years tutor of classes of young men in mathematics and experimental physics at Elizabeth, N. J. Served professionally as Electrician and Chemist in the Swan Electric Company of New York for two years. Because of past successes as a Patent Attorney at 13 Park Row, New York, was appointed, to succeed N. S. Keith, of the patent agency of the *Electrical World* and Associate Editor. N. S. Keith is known as the Translator and Reviser of Schellen's Treatise on "Dynamo Electric Machinery." Mr. Thompson for two years personally prepared and prosecuted all the patent business of *Electrical World's* Patent Agency, and is the author of a series of articles in said paper upon "Analytical and Systematic Method of Inventing," which were widely known and favorably received. Mr. Thompson is a member of American Institute of Electrical Engineers and American Society of Mechanical Engineers. He is author of the "Expansion of Polynomials," which the ablest mathematicians of the world universally commend."
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